AUG 8 1939

ENGINEERING CONSTRUCTION WEEKLY

ENGINEERING NEWS-RECORD

AUGUST 3, 1939

Interior Dept. for Yokima Irrigation Project in Washington about ready for roller gates—see p. 38

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Typical Armco Multi Plate Installations Under Railroad and Highway Fills

Diameter In Inches	Gage Numbers	Fill Over Pipe In Feet	Location
75	7 & 5	54	California
90	7 & 5	49	California
97½	1	52	Iowa
105	1	84	Colorado
120	1	68	Colorado
120	1	50	Utah
135	3 & 1	42	California
135	1	43	Colorado
135	1	41	Colorado
150	3	45	California

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Savings in erection costs are often substantial because unskilled crews can assemble Multi Plate quickly and easily in any season. No special equipment is needed and you can start placing the earth backfill immediately after all bolts are tightened. Once in place, Multi Plate structures should last a lifetime without maintenance. The galvanized base metal—ARMCO Ingot Iron —already has a 32-year service record in gages much lighter than those used for Multi Plate.

Let us show you how these practical advantages can help reduce the cost of your large drainage openings. Write to us. Armco Culvert Mfrs. Association, Middletown, O.

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THIS WEEK

● Those who have been following the development of the Mississippi River cutoff program have in this issue another in a series of reports on benefits derived from the work. The article tells how flood stages have been lowered by as much as 15 ft. and the river shortened 136 mi. in one stretch that was formerly 330 mi. long. Slopes, which were at first steep through cutoffs, have flattened out satisfactorily.

● Number one, among America's current unusual bridges, is the Lake Washington pontoon bridge at Seattle. How one of the concrete pontoon units is being built every fifteen days is told on page 50.

● John M. Carmody, administrator of the New Federal Works Agency, has prepared an exclusive article on his new department for *Engineering News-Record*. He answers the question "What will happen to the existing agencies that are being welded into FWA?"

● Caissons of several sizes and shapes were used on New York's recently completed Bronx-Whitestone Bridge. Among these was one which holds the depth record for the East—170 ft. Data on caisson design and sinking are given, beginning on page 55.

THINGS TO COME

AN IMPORTANT ARTICLE, reviewing and appraising developments in suspension bridge design, up to and including the Whitestone Bridge at New York and the Tacoma Narrows Bridge in Washington, will be published in the next technical issue. Its author, Leon S. Moisseiff, treats the subject in characteristic objective manner but, for those who do not know, it may be pointed out that he has been prominently identified with every development in suspension bridge design during the past three decades.

AN ISSUE devoted in part to waterworks in New England and elsewhere will be published on Aug. 31. Boston's new pressure aqueduct will receive a good share of attention in the number.

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CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	July 1938 (4 wks.)	July 1939 (4 wks.)	% Change	Seven Months 1938 (30 wks.)	Seven Months 1939 (30 wks.)	% Change
Total	$223,333	$181,469	−19.0	$1,478,264	$1,738,693	+18.0
Private	50,566	48,722	−4.0	538,067	432,870	−20.0
Public	172,767	132,747	−23.0	940,197	1,305,823	+39.0
Federal	55,229	24,285	−56.0	175,150	174,704	−0.3
Total New Productive Capital	$1,417,950	$817,934	−42.0	$2,487,402	$1,769,120	−29.0
Private Investment	53,263	71,148	+34.0	583,160	518,310	−11.0
Federal (non-federal work)	350,092	236,686	−32.0	754,062	429,283	−43.0
Federal (federal work)	1,014,595	510,100	−50	1,150,180	821,527	−29.0
FHA Mortgages Selected for Appraisal	$94,175	86,513*	−9.0	$549,413	$680,855*	+24.0

*Preliminary.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	August 1938	August 1939	% Change	Change July to August 1938 July	1938 Aug.	1938 %	1939 July	1939 Aug.	1939 %
ENR Construction Cost Index, 1913 = 100	232.39	234.90	+1.1	232.29	232.39	†	234.94	234.90	†
ENR Building Cost Index, 1913 = 100	194.49	196.54	+1.1	194.39	194.49	0.1	196.78	196.54	−0.1
ENR 20-CITIES' AVERAGE									
Common Labor	$0.677	$0.685	+1.2	$0.677	$0.677	0	$0.684	$0.685	+0.1
Skilled Labor (Av. 3 trades)	1.426	1.444	+1.3	1.426	1.426	0	1.444	1.444	0
Bricklayers	1.519	1.538	+1.3	1.519	1.519	0	1.538	1.538	0
Struct. Ironworkers	1.473	1.499	+1.8	1.473	1.473	0	1.499	1.499	0
Carpenters	1.288	1.296	+0.6	1.288	1.288	0	1.296	1.296	0
Cement, per bbl	$2.58	$2.60	+0.8	$2.55	$2.58	+1.2	$2.60	$2.60	0
Reinforcing steel, per cwt.	2.51	2.44	−2.8	2.69	2.51	−6.7	2.45	2.44	−0.4
Struct. Steel, Pitts.	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.24	1.21	−2.4	1.25	1.24	−0.8	1.21	1.21	0
Lumber, 2x4 Fir, per M ft.	31.24	32.30	+3.4	31.32	31.24	−0.3	32.38	32.30	−0.2
Lumber, 2x4 Fine, per M ft.	27.88	28.50	+2.2	27.62	27.88	+0.9	28.86	28.50	−1.2
Brick, common, per M	13.86	14.23	+2.7	13.79	13.86	+0.5	14.24	14.23	−0.1
Ready-mixed concrete, c.y.	7.14	7.10	−0.6	7.20	7.14	−0.8	7.09	7.10	+0.1
Struct. clay tile, 3x12x12	74.24	74.27	†	74.32	74.24	−0.1	74.2/	74.27	0
Paving asphalt, cars, ton	15.38	13.88	−9.7	15.64	15.38	−1.7	13.94	13.88	−0.4

†Less than .05 of 1 per cent change.

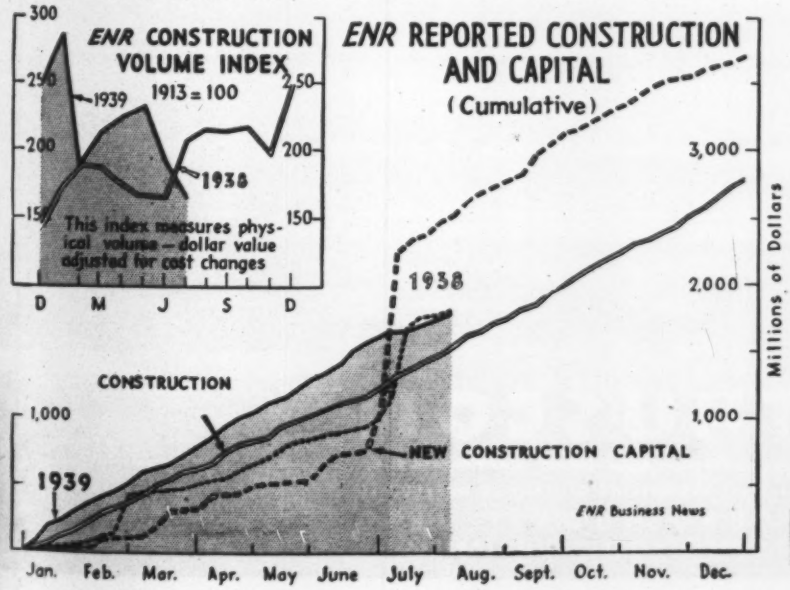
MATERIAL SHIPMENTS . . . BUILDING PERMITS

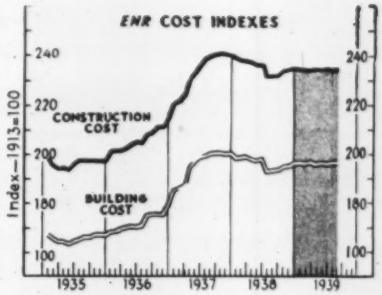
	July 1938	July 1939	% Change	June 1939	% Change June–July
Lumber (% 1929 wk. seas. av.) N.L.M.A.	55.5	67.3	+21.3	69.3	−2.9
Steel (% operating capacity) A.I.S.I.	32.0	51.3	+60.3	54.2	−5.3

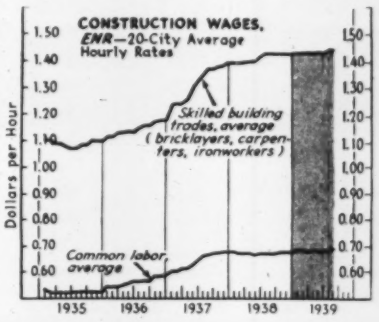
	June 1938	June 1939	% Change	Six Months 1938	Six Months 1939	% Change
Fabricated Struct. Steel, tons, A.I.S.C.	98,554	128,395	+30.0	567,255	667,066	+18.0
Cement, thous. bbl., U.S.B. of M.	10,943	12,715	+16.0	45,610	54,267	+19.0
Building Permits, Dun & Bradstreet, (,000 omitted)	$87,636	$120,912	+38.0	$527,561	$621,390	+17.8

RENT INDEX . . . EMPLOYMENT

	June 1938	June 1939	% Change	May 1939	% Change May–June
Rent (Housing) Index, N.I.C.B.	86.7	86.0	−0.8	86.2	−0.2
All Trade Unions, % Employed, A.F.L.	81.0	89.0	+9.9	88.0	+1.1
Building Trades, % Employed, A.F.L.	64.0	77.0	+20.3	75.0	+2.7







CONTRACTS

(Thousands of dollars)

	Week Ending Aug. 4 1938	July 27 1939	Aug. 3 1939
Federal	$14,864	$6,529	$2,304
State & Municipal	31,113	26,150	27,866
Total public	$45,977	$32,679	$30,170
Total private	11,477	9,455	17,308
TOTALS	$57,454	$42,134	$47,478
Cumulative 1939	(31 weeks)		$1,786,171
1938	(31 weeks)		$1,535,718

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 31 Wk.	1939 31 Wk.
NON-FEDERAL	$1,365,403	$970,146
Corporate securities	201,226	141,201
State & Mun. bonds	392,383	384,829
R.E.A. loans	11,629	89,445
R.F.C. loans	64,891	3,819
P.W.A. allotments	339,246	.....
U.S.H.A. loans	154,528	160,852
Fed. Aid—Highways	201,500	190,000
FEDERAL	$1,150,180	$821,527
TOTAL CAPITAL	$2,515,583	$1,791,673

FHA MORTGAGES

	Week Ending July 30 1938	July 22 1939	July 29 1939
Selected for appraisal	$23,540	$21,401	$20,365*
Cumulative 1939	(30 weeks)		$680,855*
1938	(31 weeks)		$555,511

*Subject to revision.

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	1926	Building Cost '13	'26	Volume '13	'26
Aug., 1939	234.90	112.92	196.54	106.24	...	...
July, 1939	234.94	112.94	196.78	106.37	166	73
June, 1939	235.02	112.97	196.41	106.17	193	84
Aug., 1938	232.39	111.71	194.49	105.14	215	94
July, 1938	232.29	111.66	194.39	105.08	207	91
1938 (Av.)	235.86	113.34	196.83	106.40	197	86
1937 (Av.)	234.71	112.66	196.15	106.07	172	75
1936 (Av.)	206.42	99.15	172.18	93.14	185	81
1935 (Av.)	196.44	94.43	165.76	89.65	134	59

July Construction Table on page 39

BIG ENOUGH FOR THE BIGGEST

and Plenty to Spare

TRUSCON STEEL HANGAR DOORS ACCOMMODATE LARGEST LAND PLANES

Ample clearance for the greatest wing spread of the largest land planes built, is provided by the huge Truscon Steel Hangar Doors installed at the Newark Municipal Airport, Newark, N. J. • Highest standards of safety for both personnel and aircraft are engineered into these Truscon Doors. Speed of operation and absolute control of the speed of these doors combine the factors of safety and the prevention of excessive heat loss from the buildings in cold weather. • Truscon Steel Window and Door Engineers are prepared to cooperate with YOU on every detail pertaining to the design, construction and operation of all types and sizes of steel windows and doors for every kind of building.

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ENGINEERING NEWS-RECORD

NEWS

Volume 123 AUGUST 3, 1939 Number 5

Huge Flood Savings From Gilbertsville

TVA estimates new dam will save Mississippi Valley $200,000,000

The economic value of the flood protection that will be afforded to the Mississippi Valley through the construction of Gilbertsville Dam on the Tennessee River is estimated at $200,000,000 in a report submitted by TVA to the President and by him, last week, to Congress. The estimate is derived from studies made by Charles W. Okey, TVA senior hydraulic engineer, and endorsed by Sherman M. Woodward, chief water control planning engineer.

Okey based his studies on the thesis that present flood protection in the Mississippi Valley is inadequate, but that an additional two feet of freeboard—obtained either through lower water levels or through higher levees—would render the valley safe. He therefore estimated the monetary value of complete flood protection in the valley, as compared with the present situation, and called this the value of an additional two feet of protection. This value he set at $381,378,000.

TVA engineers believe that Gilbertsville will reduce the maximum Mississippi flood by more than two feet between Cairo and the mouth of the Arkansas and probably by a least one foot between the Arkansas, and the Red.

(Continued on p. 36)

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Trestle Burns on Rock Island Line

A 225-ft. trestle, carrying the C.R.I.P. Ry. over a country road, burned near Melcher, Iowa, July 23. Officials blamed burning coals from an engine for the blaze. A broken journal was blamed for the derailing of 16 cars and damage to 200 ft. of track on the same line near Nevada, Iowa, the same day.

Louis R. Bostwick

LEISEN BURNS SOME BONDS

Preparatory to retiring in September from active duty as general manager of the Metropolitan Utilities District of Omaha, a position he has held since 1923, Theodore A. Leisen, watches the burning of gas and water securities in celebration of a bonded debt reduction of $1,203,000. Walter S. Bryne, vice-president and general manager of Thomas Kilpatrick & Co., has been appointed to succeed Colonel Leisen.

TVA Carpenters On Strike

Between 300 and 400 workmen are involved in a strike resulting from a dispute between AFL-affiliated carpenter and ironworker unions as to which should supply labor for certain TVA work.

The strike, which began last week, affects ten TVA projects although the work at Watts Bar Dam is most seriously affected. Gordon Clapp, TVA personnel director, has insisted that since the situation arose from a jurisdictional dispute between the unions, the authority can take no part in seeking a settlement.

Lending Bill Killed By House Action

Votes not to consider bill covering road and public-works loans

Defeat of the Works Financing Act of 1939, latest name for the so-called lending-spending bill, was indicated when the House voted on Tuesday not to consider the revised bill reported by its own banking committee. The Senate version of the bill passed but was cut to hardly more than half its originally proposed dimensions. The entire highway loan section had been omitted, but $350,000,000 for 100 per cent loans by PWA for non-federal public works and $90,000,000 for reclamation projects had been retained. A significant rider to the Senate bill was a provision repealing the clause in the 1939 relief act which requires that all relief workers who have been on WPA for 18 months or more be discharged. Dismissals had been stopped by Col. F. C. Harrington, WPA administrator, pending the outcome of the vote on the bill.

• • •

Bridge Group Named In Connecticut

Connecticut's Governor Baldwin has named a five-member Groton-New London Bridge Commission to make a study of the proposed $8,500,000 bridge to be built across the Thames River. The members are: Christopher L. Avery, Groton; O. Pomeroy Robinson, Groton; Franklin Hoadley, Stonington; Allan D. Colvin, New London; and W. Ellery Allyn, Waterford.

A bond issue will finance the construction, the bond issue to be amortized by a toll system. The commission will first determine whether the collection of tolls will prove sufficient to pay the total cost and retire the bonds in 31 years. Financing will be with the approval of the governor and finance commissioner.

CIO Plans Construction Drive

New plans for vertical union include invasion of building field, stronghold of the AFL craft unions

A full-fledged drive to organize construction workers into the CIO was indicated last week with the announcement of the formation of the Construction Workers Organizing Committee. Chairman of the committee is A. D. Lewis, brother of John L. Lewis, and the other members are the presidents of the Steel Workers Organizing Committee, United Electrical Workers, United Auto Workers, and United Rubber Workers.

Building field included

CWOC plans to organize, on an industrial basis, all workers engaged in any way on construction work, including building construction. A minor exception to this is created by the fact that the United Mine Mill and Smelter Workers Union, CIO, has already organized some tunnel and dam jobs in the West; the new committee will not take over these construction locals. Although inclusion of building construction will unquestionably precipitate, sooner or later, a battle with the powerful AFL building trades, CIO officials indicate they have no immediate intention of attacking the areas where AFL is strongly intrenched.

Nucleus of the drive will be furnished by about 50 local industrial unions of construction workers, previously chartered directly by CIO. Among the most important of these is the Baltimore building trades council, which formerly functioned, on an industrial basis, as an independent. Other places where locals exist include Detroit, Louisville, and Rochester.

Advertised features

Strongest organizing appeal that CWOC will have is its low dues schedule of $1.50 per month; moreover, in the beginning at least, no initiation fees will be charged. Another attractive advertised feature is the absence of the fee, charged by many AFL unions, for transfer from one local to another when a member changes jobs. Finally, it is believed that the industrial form of organization should eliminate jurisdictional disputes.

This last feature, chairman A. D. Lewis feels, should commend itself strongly to contractors. Industrial organization, he says, fits the way a contractor keeps his books; permitting transfer of a workman from one job to another (provided the higher of the two rates is paid), should simplify the work of the contractor, the engineer, and the architect on the project.

Rules established by the committee forbid any local to call a strike without CWOC permission. The committee recommends that locals incorporate in their contracts provisions outlawing strikes until arbitration has been resorted to. Discipline is to be maintained by empowering the committee to audit the books of any local and, for cause, to remove officers and cancel charters.

Views from the field

The proposed invasion of the building construction field, where AFL craft unions are strongly intrenched, is the most spectacular element of the plan. To secure a cross section of opinion as to the probable results of such a campaign, *Engineering News-Record* asked a number of well-informed construction leaders for brief comment. The views—in total, critical of the move, but recognizing AFL faults that CIO says it will not repeat—are as follows, beginning with those of a builder who carries on work in every part of the country and who is "convinced AFL is generally doing a good job in building trades organizations in spite of sporadic jurisdictional and other arguments. Complication of labor organizations within the building industry is likely to result in serious disorders, interruptions to work under way, increases in cost of construction (already too high in some localities), delay to new projects now under consideration, and serious confusion in the minds of employees and customers of the building industry. This must inevitably result in reducing the volume in an industry already much too low."

From various localities come these statements:

Cincinnati—It is believed that any attempt by John L. Lewis to organize the building construction industry under the CIO would meet with powerful resistance in this area, and would, if vigorously attempted, cause an endless amount of turmoil and stoppage of work. The vertical type union does have its merits, but it would more nearly fit into the field of highway and pipeline construction than of building.

However, the AFL, with its craft unions, has completely failed to recognize the importance of establishing permanent and workable machinery for the elimination of jurisdictional disputes. As a result of its failure in this respect, the AFL will lose the support of many of its own members, the building public and those contractors who have suffered financially as a result of such disputes.

Since it has been announced by CIO that no reductions in the wage scales are contemplated, it is very doubtful that a dual organization would be of any material benefit to others than the organizers.

Des Moines—Little construction work other than building in this area is organized. Should CIO enter building field, fear conditions would be ruinous. Building contractors and AFL have very little serious difficulty, with few strikes or jurisdictional controversies.

New York City—The CIO proposal to enter the building field is not regarded as a very real threat. The AFL is so strongly entrenched in most of the big building centers, certainly in the East, and the balance of the building trades' mechanics and laborers in the outlying districts of the country are so widely distributed over large areas that it would be difficult for the CIO successfully to organize them for some time to come.

Obviously if the CIO should make progress, and there was a bitter fight between them and the AFL, the effect upon building construction would be bad; when there is a bitter labor war, owners hesitate to authorize construction.

Kansas City—The consensus of authoritative sources is that an attempt of the CIO to move into the local building construction field would be practically futile. Such a movement will not succeed in the midwest for several reasons. First and most important is that the movement would meet very definite opposition from both the AFL craft unions and the building contractors. The AFL Building Trade Council of Kansas City is probably the best organized and smoothest working of any such institution in the country. The local building contractors are organized into a group known as the Builders Association of Kansas City. Confidence has been well established between these two agencies, and differences are satisfactorily ironed out with no hullabaloo or publicity. Strikes in the building trade industry are practically unheard of in this locality. If labor gets unruly the trade council whips it back into line. If a contractor steps out of line, the Builders Association disciplines him.

An attempt was made last fall by 24 CIO members to move into the building construction field in the Kansas City area. Due to the alertness of the Builders Association, this campaign was a distinct failure. The opinion also is that there is no room for two such labor organizations in the building industry. The talent of this craft is now in the AFL. In order for the CIO to move in, it must persuade these workers to desert the AFL. The workers are now satisfied and many of them appreciate the whole affair is one between two men, each ambitious to dominate the labor field.

Los Angeles—Believe any attempt to organize building industry under CIO would cause delays, confusion and probable stoppage of work in many cases. However, the possibility of an industrial union is particularly well fitted to the building industry as it could eliminate the jurisdictional dispute which has been the most costly factor in the handling of building labor. Further, restrictions on apprentices and difficulties in getting mechanics into the union when shortages existed in any given trade have dampened enthusiasm for AFL methods.

Parkway Tunnel Proposed For Connecticut

A 1,200-ft. tunnel has been proposed through West Rock, New Haven, Conn., as a part of the proposed Wilbur L. Cross Highway connecting the present Merritt Parkway with upper New England. Such a project would be the first of its kind in New England, and would pierce a 300-ft. rock cliff.

Commissioner William A. Cox of the highway department, has estimated the cost at $634,000 without lighting and ventilating estimates.

• • •

U. S. Approves Los Angeles Housing

The United States Housing Authority has approved the $1,789,000 bid of the George A. Fuller Co. of New York City for general construction of the 607 units in the Carmelitos housing project in Los Angeles County, Calif.

• • •

Whitestone Bridge Tolls Average $4,232 a Day

The first two full months' operation of the Bronx-Whitestone Bridge indicates that it is not cutting seriously into Triborough Bridge traffic, and that the combined traffic of the two bridges will exceed engineers' advance estimates.

The reports show that since the opening to traffic of the Whitestone Bridge on Apr. 29 through June 30, it carried over 1,000,000 vehicles of all classifications—an average of 16,735 a day. Its toll receipts were $256,643—an average of $4,232 a day.

A month by month comparison between May and June of this year and of last year indicates that traffic on the Triborough Bridge did not suffer seriously as the result of the opening of the new bridges, this year's traffic being but 23,954 vehicles less than for May and June of last year.

• • •

Roza Diversion Dam Ready for Gates

The Roza Diversion Dam, being built by the U. S. Bureau of Reclamation on the Yakima River above Yakima, Wash., is about ready for installation of the two 110-ft. roller gates, each 15 ft. in diameter, as can be seen from the view on the front cover of this issue. The dam is notable in that it is the smallest structure to be equipped with this type of gate. Roller gates are not new to the Bureau of Reclamation, for they made one of the first installations of this type in the country at the Grand Valley Dam in western Colorado.

Roza Dam will divert water from the river into the new Roza Division of the Yakima irrigation project, which involves the construction of 100 miles of canals and considerable amount of tunnels. About half of the canal and tunnel work is now complete. Morrison-Knudson Co., Boise, Idaho, is contractor on the dam, Bernard Williams, Superintendent. For the Bureau, C. E. Crownover is construction engineer and C. E. Klinginsmith is resident engineer.

Newark Evening News

BROKEN WATER MAIN CAUSES $10,000 DAMAGE

When a 36-in. cast iron water main broke recently in Newark, N. J., a $10,000 loss resulted. More than 3,000,000 gal. of water escaped in 5 hours. Shown is a part of the 1,000 ft. of city railway flooded by 6 ft. of water. Water Superintendent F. G. Scherer attributed the break to settling.

TVA Given Power To Issue Bonds

President signs bill which makes possible purchase of utilities

President Roosevelt on July 27 signed the bill authorizing the Tennessee Valley Authority to issue bonds for acquisition of Commonwealth and Southern properties in Tennessee, Alabama and Mississippi. He delayed signing the measure until the acquisition of the properties of the Tennessee Electric Power Co., was assured.

By signing the bill the President revoked the TVA authority to issue $100,000,000 of bonds and approved a substitute bonding authorization in the amount of $61,500,000—an amount sufficient to carry out the Tennessee purchase along with two similar purchases of Commonwealth & Southern properties in North Alabama and Mississippi.

The tax situation created in the TVA area by the acquisition by TVA and the municipalities of the Tennessee Electric Power Co. is to be met by extending in modified form to all the states in the area the percentage payments in lieu of taxes provided in the TVA Act for the states of Tennessee and Alabama. This is the solution contemplated in a bill introduced by Senator Norris on the recommendation of TVA.

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A.G.C. to Meet With Building Trades Unions

National representatives of the Associated General Contractors and of the Building Trades department of the AFL will confer officially for the first time on Aug. 8, when the Labor Relations Committee of A.G.C. meets in Atlantic City with the executive council of the building trades. Intended to initiate a continuing series of conferences, the meeting will be largely devoted to discussion of the general labor relations policy of those A.G.C. members who operate under union contracts. It is probable that the subjects will include reduction of jurisdictional conflicts, elimination of work stoppages during settlement of disputes, and stabilization of wage rates over the life of a project.

A.G.C. officials emphasize that the conference, which was authorized at the March convention and arranged at the June 5 board meeting, has no connection with the recent announcement by CIO of an organizational drive in the construction field.

Arizona's Resources To Be Developed

A state-wide development program, sponsored by the Arizona Municipal League, has been launched to include the first comprehensive plan of development of the state's natural resources.

The program includes: a treaty with Mexico to allow use of a corridor to the Gulf of California to give Arizona a seaport; formation of city authorities similar to the Port of New York Authority, to develop hydro-electric power; financial cooperation with new industries; and integration of existing irrigation projects.

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Parkway Officials Ask for Federal Aid

Unable to reach a voluntary agreement with the Indians regarding a right-of-way for the Blue Ridge Parkway through the Cherokee Indian Reservation in the western part of the state, officials of the North Carolina state highway department and public works commission are backing a bill in Congress to authorize the commission to condemn the land with or without the consent of the Indians.

Frank L. Dunlap, chairman of the state commission, appearing before the House Public Lands Committee, testified "We have made every reasonable proposition. We have offered the Indians $30,000 for the desired right-of-way which is unreasonably high, five to ten times its actual value. If we condemned the right-of-way on the basis of value, we wouldn't pay any such price as we have offered."

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Gilbertsville Flood Savings

(Continued from page 33)

Applying these conclusions to Okey's figure, they obtain the $200,000,000.

Okey divides his economic value of two feet of protection into the following classes:

Cities	$6,700,000
Railroads	10,550,000
Highways	1,500,000
Unprotected marginal areas	6,182,000
Backwater areas	32,240,000
Floodway areas	11,304,000
Reduced levee maintenance	5,290,000
Reduced seepage damage	7,612,000
Protected agricultural area	300,000,000

The first three values are equated to the estimated cost of justifiable protection by the cheapest alternative method. The next five groups are obtained by capitalizing the probable annual damage from future floods. The final figure is the estimated increase in the value of land if complete flood protection were provided.

BRIEF NEWS

TVA has asked for funds with which to raise Wilson Dam at Muscle Shoals about 2½ ft., according to Herbert S. Hudson, assistant director of the reservoir department of TVA. The new height is desired for navigation purposes.

THE Agricultural and Mechanical College of Texas plans to conduct annually a short course in air conditioning. This year's course is to be given Aug. 17, 18 and 19.

STUDIES for a possible site for the $2,000,000 bridge across the Mississippi River between Friars Point, Miss., and Helena, Ark., are soon to begin. Sverdrup & Parcel of St. Louis are the consulting engineers.

AN ANNUAL SILTING DAMAGE of more than $110,000 to 22 North Carolina municipal reservoirs results from millions of tons of soil being carried down by floodwaters from the red hills of the Piedmont, according to a survey by the U. S. Department of Agriculture.

MISSOURI'S $17,000,000 building program was pronounced complete July 25 with enough funds left over for an additional $200,000 project; the state prison will be modernized with the remaining money. Forty-one buildings at the state's eleemosynary institutions and 35 penal or correctional buildings were constructed or reconditioned as a part of the program. It was financed by a state bond issue of $10,000,000 supplemented by PWA grants of $5,100,000 and by WPA labor.

INDIANA CITIES and towns scored a victory in their fight to be relieved of payment of county and state taxes on their municipal utilities when the constitutionality of a 1939 law was upheld in the circuit court. The law repealed the act which had levied the taxes. The decision was given in the case of the Crawfordsville electric plant but will affect 238 other cities and towns which own 304 utilities.

A BILL to create a Memphis and Arkansas Bridge Commission to construct a new toll-free bridge across the Mississippi River at Memphis passed the Senate July 17. The bill would authorize the government to extend federal aid for construction of the bridge out of any money allocated to Tennessee and Arkansas, provided the state highway departments consent.

THE IOWA highway commission has ruled that all bridges with a roadway of 20 ft. or less shall be posted as narrow bridges. Previously, the commission had been posting the 219 bridges on the primary road system with a roadway 18 ft. or less. By the new ruling, 400 additional bridges will be added.

ENGINEERS INSPECT PINOPOLIS DAM SITE

EARLY THIS MONTH these PWA officials and engineers inspected the power plant and lock site of Pinopolis Dam on the Cooper River near Charleston, S. C. The river is to be made navigable up to Columbia, a distance of 145 mi., and 70 ft. of head will be developed at the dam (*ENR* February 1939). Shown, left to right, are: L. S. Harmer, principal electrical and hydraulic engineer, PWA; S. N. Vance, chief resident engineer inspector, PWA; Fulton D. Berry, resident engineer inspector, PWA; J. Henry Moore, assistant project engineer, PWA; Kenneth Markwell, project engineer, PWA; E. M. Fucik, soil technician, Harza Engineering Co.; Gregory P. Tschebotareff, professor of soil mechanics at Princeton University; Howard F. Peckworth, resident engineer inspector, PWA; and L. F. Harza, Harza Engineering Co.

New Jersey Contractor Sues U. S. Government

Wm. Eisenberg & Sons, Inc., contractors of Camden, N. J., have filed a petition in the U. S. Court of Claims, at Washington, D. C., claiming damage against the federal government in the amount of $219,390.64.

The case involves the construction of a rolled earthfill dam and appurtenant works near Beach City, Ohio. The plaintiff claims that the defendant, without warrant, disrupted and interfered with the orderly and efficient prosecution of the major operations under the contract—namely, excavation and disposal of the unsuitable overburden from the area to be occupied by the permanent concrete diversion and control works; construction of the outlet structures; construction of the main dam embankment; and construction of the dike embankment. It is claimed that due to this interference the work was seriously retarded and disorganized, and the contractor was put to great additional expense.

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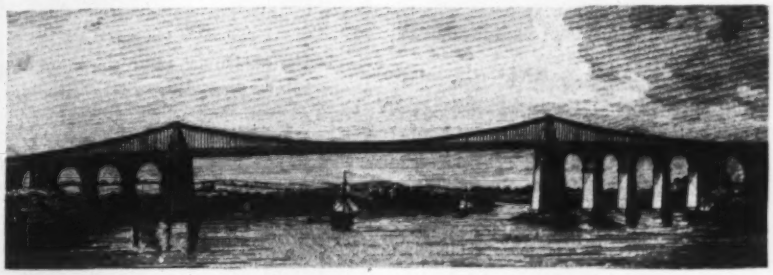
No Lottery Funds For Illinois Housing

The bill to establish a state-supervised lottery to finance slum clearance in Chicago was vetoed by Governor Horner July 25. Sponsors of the bill predicted that ticket sales would have reached $2,000,000 monthly. The governor found the plan unconstitutional.

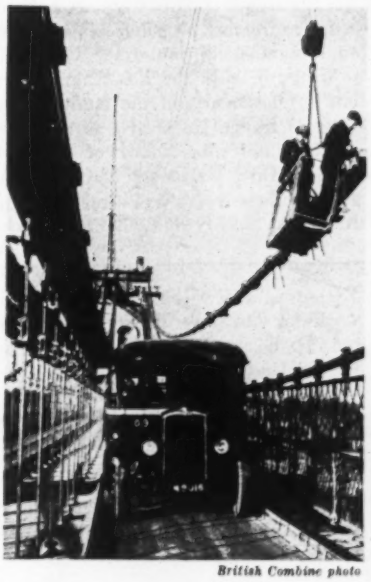


NEW CABLES, WIDER BROADWAY FOR FAMOUS MENAI SUSPENSION BRIDGE IN WALES

RECONSTRUCTION of Thomas Telford's historic suspension bridge over Menai Strait in Wales is well under way. Built in 1826, the bridge has narrow roadways posted for 4½ tons, and its growing inadequacy was emphasized by damage it sustained in a gale in January, 1936. It has a main span of 580 ft. and its deck is suspended 100 ft. above high water by four wrought-iron chain cables, each cable consisting of four chains of 5 parallel bars each. Suspenders are 1-in. square rods. Approach spans and towers are of masonry.

The present deck, as shown, consists of two 12-ft. single-lane roadways with a 4-ft. sidewalk between. Reconstruction involves replacement of the four cables with two cables of high tensile steel eyebars over the outside edge of the deck and connecting to new anchorages. This will permit a single 23-ft. roadway and a 5-ft. sidewalk at each side. The two roadway openings through the stone towers will be changed into a single large opening; sidewalks will pass around the towers on brackets.

The bridge remains in service during the reconstruction period by virtue of temporary wire rope cables, shown in the view at the right just above the railing and passing over the towers on steel supports raised clear of the permanent tower saddles. The workmen are removing the old wrought iron chains.



British Combine photo

The reconstruction will not alter the appearance of the bridge, as given in the above reproduction of an early print. The work is being carried out by the Ministry of Transport. Sir Alexander Gibb and Partners are the engineers in charge. The cost of the work, over a million dollars, will exceed the original cost of the bridge.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

HAROLD L. ICKES, arch enemy of the basing point system for cement and steel, advocates and administers the basing point set up in the Guffey Coal Act.

Decision of the Senate commerce committee not to attempt to obtain passage of the river and harbor authorization bill at this session will have no effect on U. S. Engineer operations during the current fiscal year. Money which has been appropriated for river and harbor work during 1939-40 can only be used for projects authorized before passage of the appropriation. If, however, the new authorization bill should fail to be acted upon during the next session before the 1940-41 appropriation bill, this fact might affect the size of next year's appropriation.

The bill was passed by the House authorizing projects costing $83,848,000. The Senate committee, however added so many projects as to bring the total authorization to $407,000,000. The committee last week decided not to bring the bill up at this session. Projects authorized but not yet undertaken or completed totalled, at the beginning of this fiscal year, about $275,000,000. By next year this amount will, of course, be decreased by the $55,000,000 to be spent this year on new river and harbor projects.

NEW DEAL and CIO forces are converging in a major effort to deliver the coup de grace to the AFL. The CIO drive to organize a vertical union in the building trades meshes with New Deal moves in the TNEC, Justice Department and WPA. The concerted effort comes at a time when the AFL has been weakened by the loss of its fights for amendments to the Wagner Act and restoration of prevailing wages on relief projects.

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Road Work Cut in New York State

Highway reconstruction work is bearing the brunt of an economy drive in the New York State legislature that has resulted in a cut of $26,500,000 in the state's budget of $415,000,000 submitted by Democratic Governor Lehman to the Republican-dominated legislature. The largest single item in the reductions is $10,000,000, which was taken from a $27,000,000 allotment for highways.

OBITUARY

WALTER E. CHICK, city chemist and testing engineer for more than thirty years in Harrisburg, died July 20 at the age of 65 years. He was formerly safety engineer with the Bethlehem Steel Co. He was a graduate of Tufts College.

JOHN AVERY, 75, former engineer of Perry County, Ohio, died July 23 at Lexington.

P. D. FITZPATRICK, general manager of the Grand Trunk Western R.R., died July 24. He was 59 years old. After graduating from Armour Institute of Technology, he worked with the Chicago and Northwestern and the Illinois Central R.R. before joining the Grand Trunk in 1913. He was chief engineer of the latter before becoming general manager last January. In 1927 he performed what was considered an outstanding feat of railroading by rebuilding 90 miles of track in 90 days, the track having been washed out by floods on a line in Vermont.

ROBERT B. MUIR, 74, one of the contractors who drove the Twin Peaks and Mile Rock tunnels, died July 20. A native of Scotland, he came to this country as a young man and had been a resident of San Francisco since 1910. He was identified with the construction of the Boston subways, power developments in the Skagit Mountains of Washington, and with installation of a high pressure water system in San Francisco.

THOMAS FINNEGAN, consulting engineer of the Jersey City board of education, died July 22 in Jersey City. He was 53 years old. Born in Ireland, he studied engineering upon reaching the United States and for 35 years was superintendent of the Walter Kidde Construction Co. of New York. In 1929 he resigned that position to become a member of the Jersey City board of education. Four years later he became its consulting engineer.

L. W. ANDERSON, field engineer in the construction division of the Milwaukee water department for 17 years, died recently at the age of 44.

RALPH L. GOLDBERG, engineer in charge of PWA district No. 1 in Pennsylvania, died at York July 23. He had been stationed at York for the past 18 months. Previous to that he was employed in Philadelphia.

CHESTER W. SPENCER, 66, contractor of Gastonia, N. C., died there July 24. Excepting a few years in construction work for the government in Washington, D. C., he had spent most of his life in Gastonia.

Greystone Studios

RALPH J. REED

Ralph J. Reed, 56, who retired as chief engineer of the Union Oil Co. of California in 1929, died July 27. In 1905 he received a B.L. degree from Pomona College and in 1908 a B.S. in civil engineering from the University of Michigan. Following his graduation he became connected with the Union Oil Co. to advance to chief engineer in 1918. Since retirement he acted as consultant on a number of important California projects, notably the Los Angeles harbor development and the study of Los Angeles traffic. He served as president of the California Board of Registration for Civil Engineers for four years and for three years was director of the American Society of Civil Engineers.

JOHN W. WHYTE, 80, former Louisville construction superintendent, died July 21.

JESSE SHAW, 87, for 31 years head of the water department at Topeka, Kan., and for 16 years at Tyler, Tex., died July 26.

GUY ZIGLER, 50, a general building contractor of Seville, O., died July 20.

D. P. SCOTT, building contractor, who had built many buildings in Topeka, Kan., died there July 21.

H. A. SCHOLZE, 66, a former federal engineer at Louisa, Ky., died July 20 at Gallipolis, O.

FREDERICK T. KAELIN, consulting engineer with the Shawinigan Water & Power Co., Ltd., died July 27 at the age of 66. He was born in Switzerland, studied at Zurich Polytechnic University, and came to Canada in 1902 to engage in hydro-electric work.

B. RAE KENNEY, 56, for 19 years resident district engineer for the Ohio highway department in Geauga County, died July 24.

CHARLES J. COSTIGAN, 52, former engineer for Summit County, O., died July 29, in Akron. He had been Summit county resident engineer for the state highway department for two years and was president of the Costigan-Shroyer Construction Co. He had also worked as district engineer for the Civil Works Administration.

FREDERICK S. WILKINS, retired general building contractor, died July 22 in Toronto, Ont.

TIMOTHY DOWNING, retired building contractor, died July 22 in Brooklyn, N. Y.

Backrach

AUBREY WEYMOUTH

AUBREY WEYMOUTH, vice-president and chief engineer of Post & McCord, steel erectors of New York, died July 27 at the age of 66 years. He graduated from Lehigh University in 1894 and three years later became associated with Post & McCord. In 1907 he became chief engineer and in 1930 vice-president. During those years the company supplied and erected the steel for the Empire State Building, the Chrysler Building, the Irving Trust, the Metropolitan Tower, Music Hall in Radio City and many other notable buildings in New York. In 1935 he received the honorary degree of doctor of engineering from Lehigh University.

Indiana Planning Bureau Revived

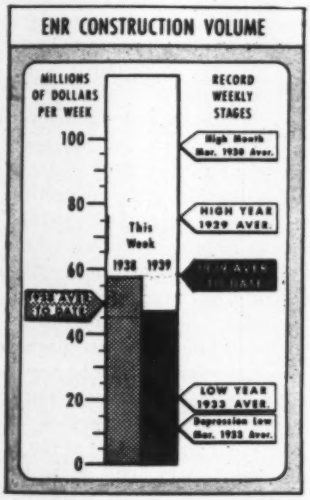
The bureau of planning in the Indiana state highway department has been revived, according to T. A. Dicus, chairman of the state highway commission. Employees of the bureau, which was virtually abolished because of the reduced personnel budget adopted by the 1939 General Assembly, will be paid by funds which have been allocated to the state of Indiana by the federal government.

The grants are based upon the federal act that requires that 1½ per cent of the highway funds allocated to states be for planning and survey. Some 25 persons, discharged because of budget cuts, were recalled for jobs in the bureau.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week total $47,478,000, a gain of 13 per cent over last week, but 17 per cent below the corresponding week last year.

Total construction awards for 1939 to date, $1,786,171,000, are 16 per cent above the $1,535,718,000 reported for the initial 31-week period last year.



Private construction for the week tops last week by 83 per cent and is 51 per cent higher than in the 1938 week. Increased commercial and industrial building volumes are responsible for the private gain. Public awards are 8 and 34 per cent lower, respectively, than for last week and last year.

In the classified construction groups, waterworks, sewerage, industrial buildings, commercial building and large-scale private housing, and public buildings gain over the preceding week. All of these classes of work, except sewerage, are above their respective volumes for the week last year.

New capital for construction purposes for the week, $22,553,000, is 20 per cent below a year ago. The current week's financing is made up of $14,433,000 in USHA loans for 19 low-rent slum-clearance projects in eleven cities, $7,720,000 in state and municipal bonds, and $400,000 in RFC loans to private industry.

New construction financing for the year to date, $1,791,673,000, is 29 per cent below the total for the corresponding 31-week period last year.

(Weekly Contract Table on page 31)

Bonds to be Issued For Texas Work

Tentative approval by the Senate commerce committee has been made of the U. S. Engineers' recommendation for flood control and power dams on the Angelina and Neches rivers in Texas. Bonds will now be issued by the districts in which the improvements are to be made.

The work is estimated to cost $28,000,000, the state or local interests contributing $5,000,000 toward the initial cost of the project. Army engineers estimated the benefits which would be derived from fulfillment of the project would aggregate $1,414,000 annually made up of reduction of flood damages, navigation benefits, power values, water supply, etc.

It is proposed to build two power dams below Rockland and large reservoirs at Rockland on the Neches and at McGee Bend on the Angelina. One low-head power dam would be on the Neches between Rockland dam and the Angelina's mouth and another below the mouth of the Angelina.

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Gentry to Head Texas Highway Commission

Brady Gentry, attorney, has been appointed by Governor O'Daniel as chairman of the Texas Highway Commission. His appointment comes after the Senate refused to confirm three other appointments by the governor.

Shortly after taking the oath of office, Gentry set the keynote for Texas' continued highway progress by assuring department heads and highway employees in the Austin office that there would be no personnel changes as long as the present work standard prevails.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN JULY, 1939

Engineering News-Record *reports projects of the following minimum costs; — water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States July 1939	United States Seven Months 1939	United States Seven Months 1938	Canada
Waterworks	342	1,956	759	1,934	397	484	5,872	118,135	49,845	548
Sewerage	235	4,677	491	1,964	1,591	33	8,991	105,049	59,663	325
Bridges, public	79	1,552	880	2,058	2,014	663	7,246	97,850	50,779	130
Earthwork and waterways	1,394	515	2,393	516	2,273	8,247	15,338	116,838	165,026	939
Streets and roads	1,629	17,320	8,823	9,039	13,015	3,117	52,943	392,477	340,099	9,958
Buildings, public	230	8,659	7,542	4,174	7,207	4,098	31,910	374,631	184,059	3,321
Unclassified, public	332	4,383	1,705	643	1,194	2,190	10,447	100,843	90,726	2,071
Total public	**4,241**	**39,062**	**22,593**	**20,328**	**27,691**	**18,832**	**132,747**	**1,305,823**	**940,197**	**17,292**
Federal government (included in above classifications)	1,491	1,833	4,402	1,969	3,705	10,885	24,285	174,704	175,150	.....
Private										
Bridges, private	25	152	.....	78	135	.....	390	2,752	4,548	80
Buildings, industrial	592	2,949	1,630	5,700	2,923	1,273	15,067	113,003	95,501	1,385
Buildings, commercial	1,515	12,625	1,974	8,620	867	800	26,401	211,951	383,190	1,596
Unclassified, private	45	1,842	748	1,027	2,314	888	6,864	105,164	54,828	962
Total private	**2,177**	**17,568**	**4,352**	**15,425**	**6,239**	**2,961**	**48,722**	**432,870**	**538,067**	**4,023**
Total Engineering Construction										
July, 1939 (4 weeks)	**6,418**	**56,630**	**26,945**	**35,753**	**33,930**	**21,793**	**181,469**	.....	.....	**21,315**
June, 1939 (5 weeks)	11,200	85,358	48,996	49,819	38,317	28,705	262,395	.....	.....	12,880
July, 1938 (4 weeks)	8,517	63,505	15,201	32,925	33,777	69,408	223,333	.....	.....	10,064
Seven Months — 1939	92,599	570,490	268,154	326,362	312,030	169,058	.....	1,738,693	.....	65,627
Seven Months — 1938	63 922	602,446	138,979	183,469	248,012	241,436	.....	.....	1,478,264	51,011

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Continuous Beam Design

Sir: I have developed a simple method of solving continuous beams, which I have used in my work, and in a series of lectures on rigid frames given to engineers. Pending its incorporation in a book on rigid frames, which I am now preparing, I thought that this particular analysis on continuous beams might prove of value to the engineering profession, and so am sending it to you as the best medium for reaching those who may be interested.

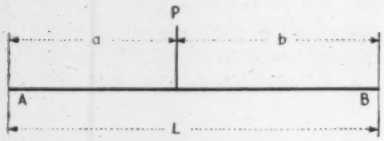


Fig. 1. One span of a continuous beam showing location of concentrated load for which fixed-end moments are determined.

The notation used is as follows:

n = ratio of L/I of the beam in question to L/I of any chosen beam. (In this case, beam BC, Fig. 2).

M'_c = simple beam bending moment of a concentrated load at its point of application.

C = the bending moment (due to concentrated loads only) at a support, considering it fixed, while the other support is considered free.

$A = C + wL^2/8$

$K = nA$

In Fig. 1, C at support A

$$= \frac{Pab}{L} \times \frac{(b + 0.5a)}{L}$$
$$= M'_c(b + 0.5a)/L$$

C at support B

$$= \frac{Pab}{L} \times \frac{(a + 0.5b)}{L}$$
$$= M'_c(a + 0.5b)/L$$

If M is the bending moment at a given support and M_L and M_R are bending moments at the support to the left and right respectively, the moment equation at each support may be written as follows:

$(n_L + n_R)M + 0.5n_L M_L + 0.5n_R M_R = K,$

K being the sum of the K values at the support for which the equation is written.

Fig. 2 shows the arrangement of the solution of a beam continuous over four spans. The following three equations are written for supports B, C and D respectively:

$2.2M_1 + 0.5M_2 = 44.28 + 56.79$
$= 101.07$ .....(1)

$0.5M_1 + 2.6M_2 + 0.8M_3 =$
$53.91 + 159.20 = 213.11$...(2)

$0.8M_2 + 3.6M_3 = 159.20 +$
$20.00 = 179.20$.....(3)

Expressing M_1 in terms of M_2, Eq. (1), and M_3 in terms of M_2, Eq. (3), and substituting in Eq. (2), Equation (2) is reduced to:

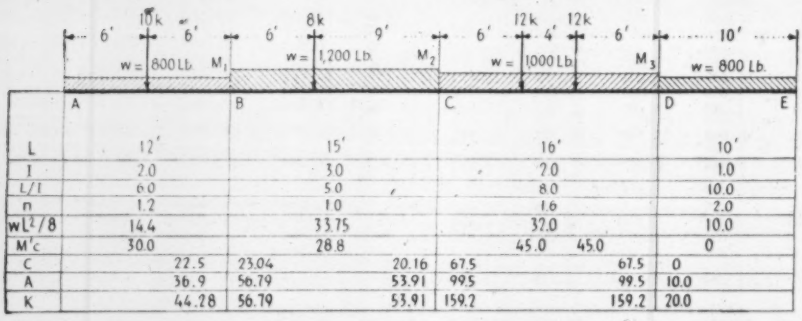
$$2.309M_2 = 150.317.$$

Hence $M_1 = 31.14$; $M_2 = 65.10$; $M_3 = 35.32$.

If the end supports are fixed the number of equations does not change. Assuming beam AB fixed at A, then $M_{AB} = A - \frac{1}{2}M_1 = 36.9 - 0.5M_1$.

Eq. (1) becomes: $2.2M_1 + 0.5 \times 36.9 - .6 \times .5M_1 + 0.5M_2 = 101.07$, or $1.9M_1 + 0.5M_2 = 78.93$.

SAMUEL NAPP
Consulting Engineer
New York, N. Y.



	A	B		C		D	E
L	12'	15'		16'		10'	
I	2.0	3.0		2.0		1.0	
L/I	6.0	5.0		8.0		10.0	
n	1.2	1.0		1.6		2.0	
$wL^2/8$	14.4	33.75		32.0		10.0	
M'_c	30.0	28.8		45.0	45.0	0	
C	22.5	23.04	20.16	67.5	67.5	0	
A	36.9	56.79	53.91	99.5	99.5	10.0	
K	44.28	56.79	53.91	159.2	159.2	20.0	

Fig. 2. Arrangement of solution of a continuous beam subjected to both concentrated and uniform loads.

Poor Building Boosts Taxes

Sir: Heavy slumps in values of buildings as a result of poor construction, in turn caused by lax financing of the past, are putting an added tax problem on the doorsteps of municipal executives. Not merely are better building codes and more vigilant enforcement shown to be needed, as the figures roll in, but laxity of financing that creates unstable tax values of buildings, like those now revealed, seems due for stern attention of mayors throughout the country.

Any city building commissioner soon becomes aware that, because of the limiting of police powers to safety and fire, many permits must be issued notwithstanding the fact that engineers of the department who have studied plans submitted are grimly aware that economic failure is ahead for bungled structures. Moreover, seldom is a building department staffed well enough to make inspections frequently enough to feel satisfied. Yet there is little cooperation on the part of the principal investors—the lenders—in requiring supervision that will assure sound construction and full compliance with requirements of building codes, if there be any worthy of the name. The present borrowers' market, with avid eagerness for new mortgage loans because of the interest rates they carry, still lacks that cooperation, the main reliance being upon Federal Housing Administration inspections, which fall far short of supervision by competent men.

Recently in New York City there was typical illustration of rate boosts when assessment values decline. The 1939 loss of values on real estate of over $100,000,000 was responsible for a 2-point increase of the city's tax rate to $2.82.

But this New York slump of assessable values, at least half of which was in deteriorating buildings, followed a 4½ billion dollar slump of non-exempt realty there during the seven years of 1932-38, accompanied by tax rate advances from $2.59 to $2.80 or 7½ per cent in the same period. For the country at large, however, the loss of assessment values was

about 15.7 per cent, or about 35 billion dollars Meanwhile the average increase of tax rates (adjusted to comparable figures) was over 15 per cent.

From the standpoint of city revenues, in years when there is desperate need for them, such an excessive slump of building values, which assessors as well as special appraisers charge to poor buildings, cuts the limit of bonding power by about one billion dollars and reduces the 1939 tax revenues by $173,000,000. But the worst is yet to come, for the buildings now slumping in values (they rarely are the ones which had good engineering and architectural service in their plans and specifications) will continue to show declines for some years to come. It is safe to say the penalty to city tax rolls, added to investors' losses in poor buildings or in mortgages, will equal the federal debt.

Soundly conceived and well constructed buildings rode out the storm with small loss in assessable values. Obviously it is not beyond expectations that building values can be stabilized. It is equally obvious that city officials will be in for upsets at hands of taxpayers when tax rate advances keep pace with the assessment slumps, if no steps are taken to improve code requirements and enlist mortgage lending interest in control of standards of new structures.

When the tragedy of a building collapse in New York in 1936, in which 18 lives were lost, brought about formation of a Vigilance Committee to remedy conditions, one proposal which was debated and favored by the various sub-committees of engineers, architects, contractors, labor, building commissioners and others (except the lenders) was the rating of merit of structures. Such a rating plan has so transformed standards of ship construction that rarely today is any ship launched that fails to rate A-1. Similar discrimination on the part of those who finance buildings would supply an incentive to builders to show how well they can perform particularly if there were attached a penalty for failure to do good work. Such an incentive has been lacking in building construction, with the result that sound planning and erection are at a discount while professional service is either dispensed with or underpaid. Today the slump of assessment values, on top of stupendous investment losses, measures the penalty being paid for the lack of insistence on good building standards.

EDWIN H. THATCHER
Former Commissioner of Buildings
Borough of Brooklyn, City of New York

Steel String Concrete

Sir: The various methods of prestressing the steel bars in concrete are almost as old as ordinary reinforced concrete. However, in the long and persistent efforts to find the most suitable method of prestressing the steel bars, the fact was overlooked that the applied tension was too low to insure the proper utilization of the composite material. Inadequate prestressing, combined with the use of comparatively thick bars, has retarded materially the progress in this direction.

Recent developments in Germany show that the problem of prestressing reinforced concrete structures has entered a new and decisive phase. By an ingenious combination of high tension and thin steel reinforcement a product—steel string concrete—is obtained, manifesting characteristics similar to those of wood and steel. Compared with ordinary reinforced concrete the savings in steel are up to 85 per cent in certain cases.

The reinforcement consists of very thin strings $\frac{1}{64}$ to $\frac{5}{64}$ in. in diameter of high carbon (not alloy) steel, cold drawn and specially treated to develop an ultimate strength of 400,000 and a yield point of about 340,000 lb. per sq.in. The high strength concrete of properly graded aggregates that is used develops an ultimate compressive stress of 11,000 lb. per sq.in. after 28 days.

The steel strings are placed close together at top and bottom of the beam and stressed in tension to 250,000 lb. per sq.in. After the concrete is poured and hardened the ends of the strings are released and the beam is ready for use.

Due to high tension and thinness of wires, the question of bond between steel and concrete is eliminated entirely. The beam remains almost free of tension cracks up to the crushing strength of the concrete. It can be cut at any place normal to the longitudinal axis without losing its remarkable properties. Under these circumstances hooks at the ends are not needed. The beam under heavy loading deflects considerably, returning to its original position after the loading is removed.

At present mass production of steel string concrete beams of various shapes is contemplated to be used in the same way as the commercially available steel and wooden beams. However, the possibility of applying steel string concrete to monolithic structures is not excluded by any means.

The inventor of this useful and preeminently practical structural material is a German engineer, Eward Hoyer.

A. FLORIS
Los Angeles, Calif.

Setting Farley Straight

Sir: It is a great relief to note, after reading your correspondent's account (*ENR*, July 20, p. 43) of the Atlantic City convention of the A.W.W.A., that he still approves the activities of the Atlantic Ocean.

By way of defense of the fine services of Chairman L. H. Enslow and the rest of the program committee, the confusion in dates which so greatly disturbed your correspondent should be understood to be the error of the printer's craftsman who assembled text material (already proofread) and inserted a set of dates designed to make the use of the program easy. The error will be remembered as one not quite complete since concession was made by the printer's particular devil to the extent of setting the days of the week correctly.

Your correspondent and the many others present at the record-breaking Atlantic City 1939 A.W.W.A. convention can now look forward to the 1940 meeting at Kansas City. There another fine auditorium will be used for exhibits and meetings. The Phillips, President and Muehlebach hotels will serve as co-headquarters for housing the attendants. The dates are set for April 21-25, 1940 and follow immediately after the spring meeting of the A.S.C.E. (April 17-19) in the same city.

Your correspondent cannot depend upon the Atlantic Ocean for repose. The Missouri River will have to suffice. And there will probably be a mistake in the program, not the same one but another just as good or bad, depending on how one looks at mistakes.

HARRY E. JORDAN
Secretary, American Water Works Association, New York

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Editorial Offices at 330 West 42nd Street, New York

AUGUST 3, 1939

PUBLIC WORKS INTEGRATION depends for its success so greatly on early policies and direction that the statement of Administrator John M. Carmody, which we are able to present this week, is timely and important. A skilled administrator who won his spurs in the Rural Electrification Administration and in earlier work as engineer, executive and editor, Mr. Carmody also is thoroughly familiar with engineering and construction. His statement shows full realization of the individuality of the bureaus in his charge, and appreciation of the ability with which they have been directed. The bureaus are to continue undisturbed, which will be welcome news to all; where cooperation is practicable it will be utilized; programs and schedules of requirements will be developed, an aid to the service industries and hence to the general economy. Thus, federal construction integration is off to a good start. While nothing is said of the necessary separation of relief from construction, this may be expected to be dealt with in accord with the objective of efficient construction, and in due course an approach to better planning and programming of federal public works will emerge.

Bridge vs *Truck*

WEEK AFTER WEEK a common headline in our news pages is "Bridge Collapses When Truck Hits It." Such chronic disaster heaps unjust discredit on bridge and highway engineers. It is unjust because money to remove inadequate bridges is often not available and because laws are too lenient in the matter of truck dimensions, speeds and loads. But if the engineer is free of direct blame, he is at fault for failing to complain about conditions or making his complaints effective. No opportunity should be missed to point out danger spots, to discourage repair of old bridges that should be scrapped, to insist on straight approaches, wide roadways, strong floors and indestructible guard rails. And every complaint should be recorded, so that it can be produced as evidence when the prophesied accident occurs. Moreover, highway engineers should extend their complaints to truck regulations and enforcement, for even new bridges are vulnerable to truck impact. The battle between bridges and trucks is too one-sided at present.

Practical Precedent

ILLUSTRATING THE FACT that well-conducted sanitary-fill practice saves money and produces civic assets, Seattle's experience reported in this issue is worthy of close attention on the part of city engineers and sanitary officials. It constitutes a practical precedent of much value in view of the city's long record of use of refuse disposal by fill. Because of differences in climate and other factors, not all items of the Seattle procedure may be adapted to practice elsewhere; the important teaching of the case is that fill disposal has long been satisfactory and efficient and that rigid sanitary control is practicable.

Review Called For

THE THICKENED-EDGE PAVEMENT is a failure, says a well-known student of pavement service records on another page. Too many unwarranted design assumptions vitiate reasoning based on sound principles of mechanics, he holds, with the result that pavements are much less durable than dams and bridges. This criticism of the thickened-edge design does not stand alone. Many state highway engineers have refused to adopt it, and research studies are supporting them; the latest evidence, reviewed by E. F. Kelley (*ENR*, March 30, 1939), points to needed improvements in thickened-edge design and indicates certain advantages of the uniform pavement. Clearly engineers cannot rest content with present rigid-pavement design. Review is in order.

Watts for Coal

FOR numerous industrial processes the use of electric heat is old enough that it no longer is news. In construction, however, except for house heating in the camps of some of the western dam projects, the substitution of watts for coal is an infrequent event. The use of electricity to heat asphalt, as recorded in this issue is, therefore, worthy of emphasis. Cleanliness, elimination of boiler firing, and maintenance of uniform tem-

perature for the asphalt are listed advantages. By taking current during off-peak periods, attractive rates were obtained. It is possible that there are other construction industry operations that might benefit from the use of electric heat. An example, which will be described in a future issue, relates to electric heat as an aid in curing shop-fabricated concrete joists. Wire grids placed between the joists in the forms speeded up operations, eliminated salamanders and gave uniform curing throughout the length of a 20-ft. joist for the cost of 1.6 kwh of electricity. Whether to substitute watts for coal in a particular process is of course an economic question, but the fact that some engineers have found such substitution useful suggests that inquiry and study are worthwhile.

Trouble Ahead

ANNOUNCEMENT by the CIO that its United Construction Workers Organizing Committee plans to unionize "2,000,000 unorganized construction workers" spells trouble. In theory the plan is good, for the CIO idea of industrial organization is better suited to construction than is the rigid AFL craft system, especially in heavy and highway work. Free transfer of men from one job to another, as advocated by CIO, would mean more efficient distribution of construction labor, to the advantage of both worker and industry, and prevent the wasteful inter-union squabbles that are a constant exasperation. But however desirable the plan may appear, the construction industry is in for a big headache, if the present announcement is followed up by a vigorous organizing effort.

It is certain that the CIO scheme of organizing only the non-union construction workers is but a step toward control of the entire industry. Constant trouble in the auto plants and the threatened strike in the packing industry are examples of what is ahead for construction when the CIO-AFL warfare for domination breaks out. Then, too, CIO leadership has shown no more ability to control minor officials or obstreperous locals than has that of AFL; contracts or the welfare of workers mean nothing in manoeuvering for position and power.

Under the present national administration labor has obtained more protection and privilege than ever before in our industrial history. Yet abuse of those rights and the power they give has dropped public opinion of organized labor to a low level. If the CIO efforts to break into construction in a big way mean the pursuit of the same old tactics—and there is no indication of change—warfare and disruption of the construction industry are certain, and the cause of labor will receive another setback.

Construction labor deserves and needs the protection of better organization than it often now enjoys. Yet a peaceful achievement of this need seems impossible under the present labor system and leadership. In the storm that is coming workers and the construction industry will both suffer.

Achievement

SIX YEARS' WORK has transformed the lower Mississippi River. The record set forth in this issue reveals how an ever-present flood threat has given way to controlled flow in an efficient channel and demonstrates that one of the great problems of hydraulic engineering has been solved. Honor for the achievement is due first of all to Gen. Harley B. Ferguson, but also to those at Washington who approved and supported the bold plan that he conceived and executed.

Long-standing precedent had to be discarded to make the achievement possible. It was necessary to create a new conception of river action, resting on use of the river's own energy and adjustment of the channel to energy, load and banks. In practical application this conception proved that it is possible to attain the slope required by an efficient channel, and that slope and channel can be made uniform where natural obstacles do not prevent.

The most important result perhaps of this successful channel building is that need for the Boeuf or Tensas floodway has been eliminated. Most bitterly disputed element of the plan initiated after the 1927 calamity, this diversion channel now has no reason for existence. When like improvement can be extended upstream to the mouth of the Ohio and the critical Cairo problem thus done away with, control of the river will be complete.

Thus the river begins a new period in its history. The problem of the future will be to maintain what has been created, for the lesson of the past is that regular care is essential to the security of the stream. Increase of headwater reservoirs, useful in reducing flood volumes, will not remove the need for painstaking care to keep hydraulic conditions in the river channel at their best. What has been learned in the successful pioneer work of the past six years goes far to assure the success of this future task.

FIG. 1. INCREASING THE MISSISSIPPI'S CAPACITY: GILES CUTOFF IS BEING DREDGED AND VIDALIA POINT CUT BACK.

Mississippi River Cutoffs Effective

Contents in Brief—This year's high water showed that flood stages have been lowered as much as 15 ft. by the cutoffs and associated channel improvement work inaugurated six years ago. Following the shortening of the river by 136 mi., full development of the cutoffs has restored the original slope of the river. A statement by Gen. Ferguson, who conceived the work, explains the use of sand training dikes and corrective dredging to convert disorderly reaches of the river into channels efficient in hydraulic and navigation service.

SPRING HIGH WATER this year furnished the most significant test yet obtained of the effectiveness of the cutoff and channel-improvement work that has rebuilt the Mississippi River during the last six years. Its flood levels above Vicksburg were 10 to 15 ft. lower than those of 1933, when the work began. The carrying capacity of the river has been so greatly improved that today it is doubtful whether the controversial Tensas Basin floodway could be used if built.

Graphical comparison of 1939 flood stages with those of equally large prior floods brings out the stage-lowering effect clearly. The flood profiles plotted in Fig. 2 reveal the progressive reduction of flood heights for roughly comparable volumes of flow, about 1½ million cfs. Maximum floods may reach discharges of 2½ to 3 million cfs, and while under such conditions the effect may be somewhat different in degree, it is certain that a large reduction of flood heights would be realized even then.

Expressed in other terms, the improvement of the river is shown by the increase in discharge at identical stages. The carrying capacity of the channel at the Vicksburg Bridge was about 100,000 cfs greater in 1939 than in 1937, a gain of about 10 per cent. Some distance upstream at Arkansas City, Ark., the carrying capacity increased by 544,000 cfs. or 71 per cent in six years. The detail figures are given in "Progress Report, Flood Control Work", of the Mississippi River Commission for March and April, 1939.

River shortened by cutoffs

It will be recalled that, beginning with the Diamond Point cutoff some 12 mi. below Vicksburg, 13 cutoffs were made, extending from Arkansas City to Natchez and including the wellknown Greenville Bends. A river length of 330.6 mi. was thus shortened by more than one-third, or 115.8 mi. Further shortening by about 20 mi. resulted from enlargement of chutes and channel straightening by the river unassisted. The total shortening therefore is 136 mi., reducing the former 330 mi. to a present length of 194 mi.

In the course of this change also the river has improved materially in channel cross-section and in uniformity of dimensions. The facts are well set forth in Fig. 3, which indicates how the cross-sectional area of the river has increased and become more uniform as a result of the improvement operations. Each bar represents the mean area of a 10-mi. section, from surveys in 1925, 1932–35, and 1937–38.

The increase of channel cross-section at bank-full stage below Arkansas City during the 5 years was about 15,700 sq. ft., or 7.6 per cent—equivalent to removal of 500 million cu. yd. of material from river bed and banks, without counting the yardage that came out of the cutoff channels. In rough terms about 90 per cent of this total yardage was removed by the action of the river itself; only about 10 per cent was removed by dredging. There is evidence of further enlargement since the 1937 survey, but complete figures are not yet available.

Last year a summary of the progress of cutoff operations, prepared by George R. Clemens (*ENR* Nov. 17, 1938, p. 608) showed that 5 cutoffs had then developed fully enough to carry most of the high-water flow and furnish adequate navigation at

low water. This development has proceeded farther toward completion during the past year, and at present all the cutoffs are in full service, as indicated by the table below:

ENLARGEMENT OF MISSISSIPPI CUTOFFS, 1936-1939

Measured by per cent of high-water flow of river passing through cutoff; for low-water performance see note below table.

Name of Cutoff	Per cent of river discharge April-May 1936	March 1939	Increase since 1936
Caulk	0	80	80
Ashbrook	80	87	7
Tarpley	58	67	9
Leland	81	100	19
Worthington	27	67	40
Sarah	10	65	55
Willow	42	80	38
Marshall	42	61	19
Diamond	60	70	10
Yucatan	87	90	3
Rodney	13	54	41
Giles	35	64	29
Glasscock	14	44	30

Low-Water Improvement — During the low water of 1938, 7 of the 13 cutoffs carried the entire river flow and 6 carried volumes varying from 70 to 80 per cent of the main river flow. The *average for all the cutoffs* was close to 90 per cent.

River slope adjusts itself

At various times engineers familiar with the Mississippi River have expressed the fear that cutoffs might produce unduly steep water slopes. For this reason the Mississippi River Commission has paid close attention to changes of slope that followed the opening and enlargement of the cutoffs. These studies give evidence of a marked tendency for the river to rebuild the slopes that characterized its prior profile, whenever it has a chance to scour its bottom. At some points this slope-flattening was retarded by tough bottom materials, but after corrective dredging the river produced effective scour.

Demonstrating this effect, the high-water profiles of 1939 and 1937 (Fig. 4), show that the river rapidly adjusted its slope. Both profiles were obtained at or near flood crest. Within the cutoffs the slope changed greatly, but between cutoffs no appreciable change occurred. Thus, above Glasscock Cutoff the 1937 slope averaged 0.28 ft. per mi., while the present slope is 0.25 ft. per mi. Above Giles Cutoff the corresponding

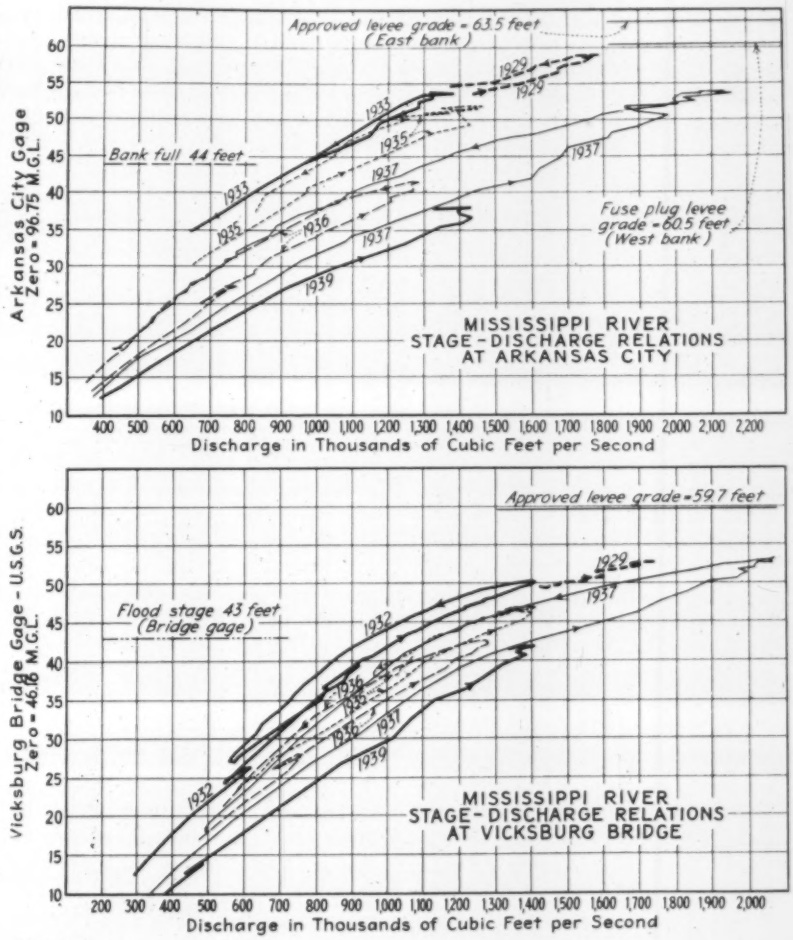

Approved levee grade = 63.5 feet (East bank)
Bank full 44 feet
Fuse plug levee grade = 60.5 feet (West bank)
Arkansas City Gage Zero = 96.75 M.G.L.
MISSISSIPPI RIVER STAGE-DISCHARGE RELATIONS AT ARKANSAS CITY
Discharge in Thousands of Cubic Feet per Second
Approved levee grade = 59.7 feet
Flood stage 43 feet (Bridge gage)
Vicksburg Bridge Gage - U.S.G.S. Zero = 46.8 M.G.L.
MISSISSIPPI RIVER STAGE-DISCHARGE RELATIONS AT VICKSBURG BRIDGE
Discharge in Thousands of Cubic Feet per Second

Fig. 2. Six years' work in shortening the lower Mississippi River resulted in a large reduction in high-water stages this spring as compared with conditions before the improvement.

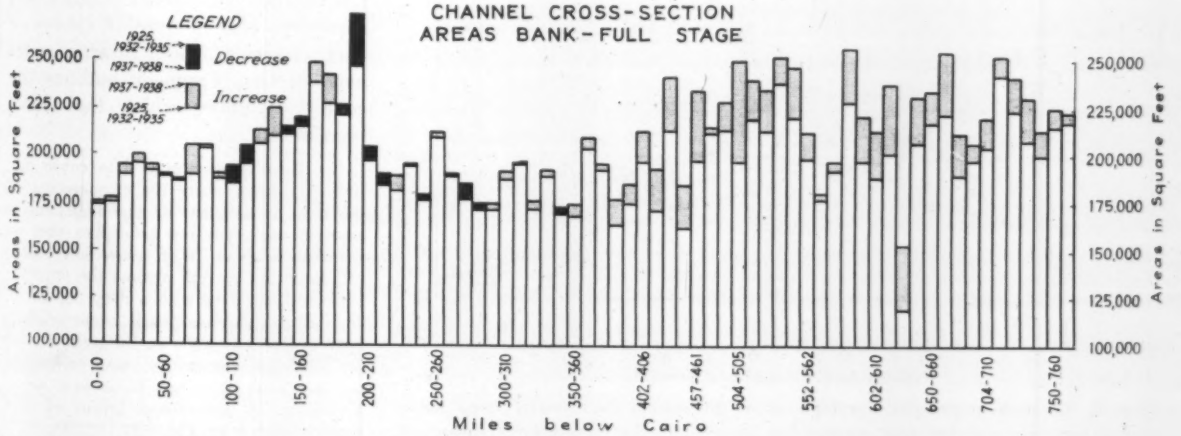


Fig. 3. Old Man River is taking on more uniform dimensions as the result of slope regulation by cutoffs and controlled scour directed by training dikes. The diagram shows the changes in cross-sectional area that have occurred between 1933 and 1939 on 770 river miles from Cairo to Angola.

slopes are 0.29 ft. and 0.31 ft.; above Rodney, 0.35 ft. and 0.34 ft. respectively. The steep fall existing in each cutoff after it was first opened soon flattened out. Rodney Cutoff went from a slope of 0.54 ft. per mi. in 1937 to 0.38 ft. per mi. in 1939; Giles Cutoff from 1.31 ft. to 0.60 ft.; Glasscock from 0.98 ft. to 0.53 ft.

Due to this adjustment of the cutoffs a cumulative stage-lowering effect developed, which Fig. 4 brings out clearly.

The safety of the valley

What the flood-stage reduction means to the safety of the valley may be summarized in simple terms if we recall the fact that heretofore the 300-mi. section from the mouth of the Arkansas to Angola has been the dangerous bottle-neck of the river. Here the highest feasible levees were not believed to afford assured protection against extreme floods, and it was for this reason that the 1928 flood-control plan contemplated the construction of a great floodway through low-lying agricultural areas west of the river—the bitterly contested Boeuf Basin floodway, later replaced by a more easterly floodway location, in the valley of the Tensas River.

At that time it was not believed possible that the capacity of the channel could be increased by any practicable method sufficiently to lower flood levels to a safe point. The successful system of cutoffs and dredging operations initiated by Gen. H. B. Ferguson, president of the Mississippi River Commission, in the face of almost universal skepticism accomplished this increase of capacity and has now demonstrated that the former bottleneck is eliminated. The need for a floodway is past.

In the light of the current year's experience as revealed by inspection of the river and study of channel and flow records, the following accomplishments may be recorded: (1) The cutoffs are efficient and due for further enlargement, and through restoration of the prior river slope have lowered the Mississippi's flood stages decisively. (2) In the course of this improvement, aided by regulation of width and alignment as outlined below, navigation depths over the crossings have been improved, the channel cross-section and capacity has been increased, and the river has become more stable. (3) Even in extreme floods the river may not reach stages high enough to enter the "fuse-plug levee" or spillway at the entrance to the proposed Tensas Basin floodway, and the floodway therefore may never be built. (4) Long, gently curving reaches of the river have been created, whose behavior in high water indicates that they are likely to be as stable as is compatible with alluvial river characteristics.

A final result, and one of much significance, is that river maintenance during the last two years has been much less costly than in earlier years. Main items in the reduction are lessened need for dredging to keep navigation channels open and elimination of much revetment maintenance.

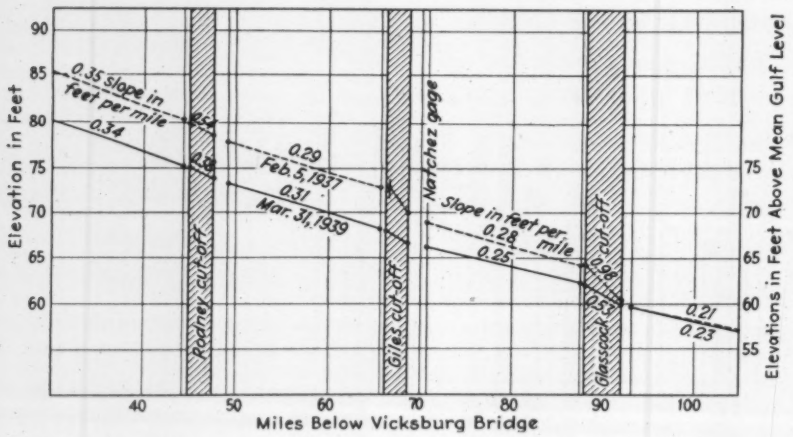


Fig. 4. Through progressive development of the cutoffs the initially steep water-surface slope through the new channel has flattened to the former river slope, and water stages have been lowered correspondingly. This stage-lowering effect is shown here by comparison of the 1939 and 1937 profiles of the Vicksburg-Natchez section of the Mississippi.

Making the channel efficient

Cutoffs by themselves are not enough. While they correct the instability and inefficiency at sharp bends and loops of the river, where much head is lost by excessive river length, they do little to correct conditions in the reaches between these bends. Many such reaches are inefficient, or as Gen. Ferguson has often described them, "disorderly". It was therefore found necessary to do extensive work between the cutoffs to improve the alignment, width and depth of the channel.

This work has involved two procedures, generally used in combination: (1) Directing the flow and closing off pockets formed at unduly wide points of the channel, by training dikes of dredged sand fill. (2) Regulating width and alignment or deepening the channel at critical points partly through the scour induced by the training dikes and partly through local dredging. The general objective of the work was to create a uniform river width—which in the lower river appears to be in the neighborhood of 4,000 ft. between banks—and to establish where feasible a central river channel which is deep enough to maintain itself by normal scour action.

Sand dikes

Extensive use has been made of training dikes, in most instances to direct the current for proper scour action or to limit the width where the river spread out too far to maintain the desired efficient channel, but sometimes also to close off chutes or back channels. The following statement of Gen. Ferguson outlines the conditions under which they have been used:

(a) Sand dikes are used to cause erosion of a bank where the cross-section of the river is deficient or the alignment is unsatisfactory. The low sand dike, that is, one that is about 10 ft. above low water, will force the current against the opposite bank and, together with a deep cut 70 ft. deep along that bank, will cause erosion. Such a dike was made on the right side of the low-water channel to cause erosion of the left bank at Kings Point just above Vicksburg. A generalized layout of this work is shown by Fig. 5A.

(b) Sand dikes are sometimes used to close or nearly close secondary channels. Such a dike or dam was built across the

head of the old bendway channel at Racetrack, Fig. 5B.

(c) Another class of sand dikes used is simply a dike prolonging the highwater bank at the shore end or base of the growing sandbar. Such a dike causes high water to erode part of the sandbar in front of this dike and prevents the sandbar from growing excessively and causing erosion of the opposite bank. This type of dike is exemplified by one constructed on the left at the head of Racetrack Chute, Fig. 5B; it is simply a prolongation of the highwater bank.

(d) There is another situation in which we have used sand fills or sand dikes. Where the river is too nearly straight it is likely to develop a long crossover, with channels along the banks separated by a sandbar and finally by an island in the middle of the river. Such development actually occurred at Waterproof Reach. To prevent the occurrence of a similar condition immediately above Giles Cutoff a sand fill was placed on the right at the upper end of the long crossover (about 4 mi.), as shown by Fig. 5C. A sand fill was also placed on the left at the lower end of this crossover. These two dikes prevented the bank from eroding and caused the river to scour a satisfactory central channel.

In general, I have found that by the use of sand dikes and dredging the bank can be held when alignment is satisfactory, or a bank can be moved back for correct alignment or increased cross-section.

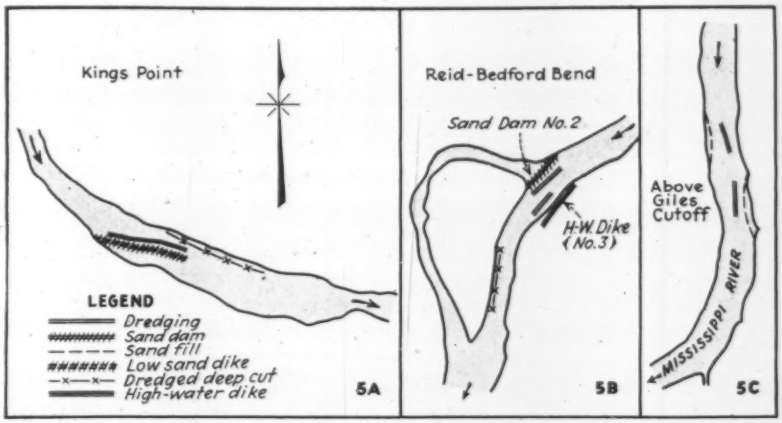


Fig. 5. Typical applications of sand training dikes, sand dams for closing chutes, and corrective dredging.

Channel-improvement dredging

In planning and executing the channel-improvement works by dredging in conjunction with sand dikes, the effort has been to make the river do as much work as possible. The dredging is primarily directed toward utilizing the river's energy.

Dredging in the reaches between cutoffs is largely intended to transmit the effects of the cutoffs upstream through "disorderly" reaches of the

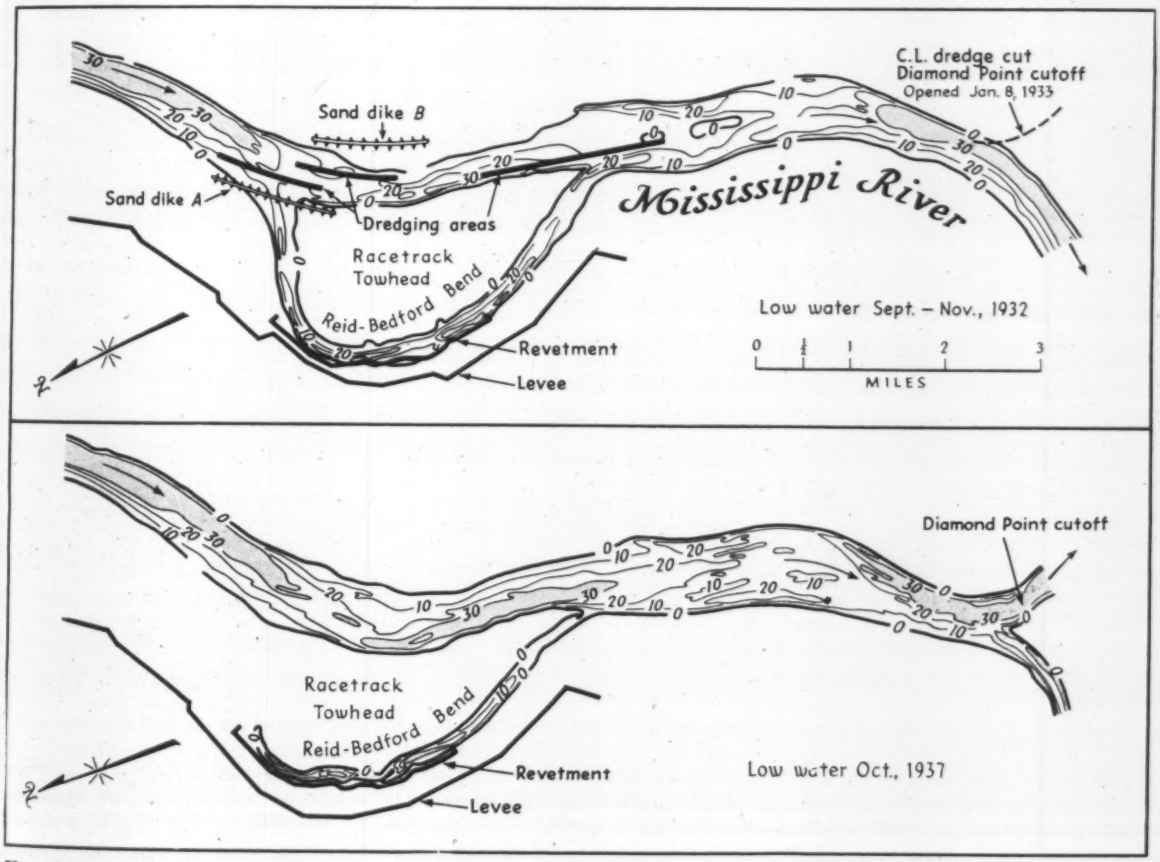


Fig. 6. Racetrack Reach is an example of how the river has been improved by alignment regulation through training dikes and dredging. The river curvature has been corrected, an island eliminated by closure of the back channel, and an efficient, stable reach produced.

river. In nearly all cases such reaches were found to contain non-erodible material, originating from earlier channel changes. Examples are Racetrack Reach, Buckridge Reach, Natchez Island, and Fords Crossing.

A typical illustration of the use of dredging for the channel between cutoffs is found in Racetrack Reach, which formerly was a narrow chute but today is the main channel of the river. Racetrack Reach is a short distance below Vicksburg and immediately upstream of Diamond Cutoff; it includes the first shoal section above the cutoff, and has (or had) a divided channel at Racetrack Towhead. The upper drawing in Fig. 6, showing conditions at this point in 1932, makes clear that the river maintained a deep channel west of Racetrack Towhead and a shallow chute east of the towhead. In 1933 a program of dredging and sand-dike construction was undertaken to develop a single channel of full-sized river dimensions along the line of the chute.

Two sand dikes, A and B, were built at the head of the chute. Dike B was built to bank-full height, and extended along about one-third the length of the chute; the materials for its construction were dredged from the river and pumped to place. Dredging was done across the shoals at the upper and lower ends of the chute, as shown by solid black areas. Dike A was built across the entrance to the old river bend, also by pumping sand from the channel. During the fall and winter of 1934–35 its top was 15 ft. above low water, but in the following season it was rebuilt to 20 ft. above low water, and in 1936 was finally improved by raising its upstream end to bank-full elevation.

The dikes and the dredging operations in the chute promoted the enlargement of the channel and removed the shoal below the chute. Dike B assisted in confining the flow to the chute by cutting off flow over areas far beyond the low-water channel, and caused the river to scour its bed actively.

Together, these operations established the river in the chute and closed the old bend channel for ordinary stages, as indicated by the lower chart, plotted from the 1937 survey. Enlargement of the chute into a full-sized river channel involved the removal of 63 million cu. yd. from the bank-full cross-section in 3 years. Only 12 million cu. yd. of this total was dredged, while 51 million was removed by the river itself. The action of the corrective work was supplemented by the effect of Diamond Cutoff (at extreme right).

Natchez Constriction

One of the major operations of channel regulation is now in progress opposite Natchez, where a point has long existed, occupied by the town of Vidalia. Confined between Vidalia Point and the high Natchez bluff, the river is little more than 2,000 ft. wide, while its prevailing width elsewhere is about 4,000 ft. The resulting constriction is revealed by a hump in the highwater profiles, which raises flood levels and is harmful to channel stability both above and below. Hard ground in the bottom of Giles Cutoff, a few miles above Natchez, intensifies this hump.

Present work therefore includes dredging Giles Cutoff to greater depth through the hard bottom and cutting back Vidalia Point. The town of Vidalia must be moved back, a job which is being carried out by the Louisiana Levee Board, using funds provided by the Mississippi River Commission equal to the appraised value of the town properties. Pending completion of the removal, a temporary levee has been thrown up just in front of the town to permit dredging to begin along the river bank. Somewhat complicating the entire operation is the construction of the Natchez Bridge across the Mississippi, whose piers now are being built by the Dravo Corp., of Pittsburgh.

Completion of the Giles-Vidalia correction will remove the last major irregularity of the slope below the Arkansas River, and will produce a smooth profile consistent in its hydraulic action.

Delta flood control

The present year's experience on the Mississippi in conjunction with the observations of flow through Bonnet Carré spillway (20 mi. above New Orleans) in the 1937 flood also proves that Bonnet Carré is adequate to take care of all flood conditions below the Morganza Floodway. Correction of throttle points in the outlet channel below the spillway of Bonnet Carré was completed in January, and the spillway henceforth should be capable of carrying substantially more than the 250,000 cfs. for which it was designed.

Enlargement of the main channel in the Atchafalaya Basin is still in progress, and a second outlet below Grand Lake, supplementing the present outlet of the Atchafalaya at Morgan City, is about half excavated. A railway and a highway bridge over this new (Wax Lake) outlet are to be put under construction this summer. The levees of the Atchafalaya Floodway are substantially complete, and construction of the spillway near Morganza, La., to form the entrance to this floodway should be taken in hand soon.

Thus the control of the lower Mississippi River is virtually an accomplished fact. A safer and more stable river is in sight on conclusion of the current operations.

How the work evolved

Nine years ago the problem of controlling and stabilizing the lower Mississippi was made the subject of an intensive study by Gen. H. B. Ferguson, then division engineer of the South Atlantic Division of the Engineer Corps, at Norfolk, Va. As a result, late in 1930 he outlined a cutoff and dredging program substantially as later carried out. The report was approved by the Board of Engineers for Rivers and Harbors and by the Chief of Engineers, and its execution began late in 1932, when Gen. Ferguson was named president of the Mississippi River Commission.

In detail the subsequent evolution of the work was a trial-and-error process, and encountered many complications. It was guided by continuous close study of river slopes, depths and currents, which at each step gave further support to the theory on which the plan rested, namely that the energy of the river itself could be utilized to shape and maintain an efficient channel.

At some of the cutoffs, limitations on location of cut prevented attaining the preferred alignment, and at certain points hard ground slowed up the development of a cutoff. The result exhibited in the current year's experience on the river shows, however, that all difficulties were successfully overcome, and that the river shortening and channel regulation have completely transformed the river from the uncontrolled condition in which it existed since the white man first saw it.

Salvaging Streets with Oyster Shells

Worn-out streets in Jacksonville are resurfaced with oyster shells crushed and rolled in place

AN ABUNDANCE of oyster shells conveniently dredged from the harbor furnishes one of the principal raw materials for surfacing streets in Jacksonville, Fla. On street restoration alone, 250,000 sq.yd. of surfacing is being undertaken at the present time. The cost, with WPA labor, is 40 to 45c. per sq.yd.

Many old streets in Jacksonville with an oyster shell or limerock base and a thin bituminous surface are being improved. The methods used are as follows: The old pavement is scarified to a depth of 4 in., and then compacted with a roller. Subsequently it is scarified lightly and shaped with a blade grader. Over the prepared surface is spread 2 to 4 in. of oyster shells. These are hydraulically dredged in the harbor, and are free from mud or other foreign material. They crack and break very easily when rolled. And since they are 98 per cent calcium carbonate, they produce a cemented mass under the action of water.

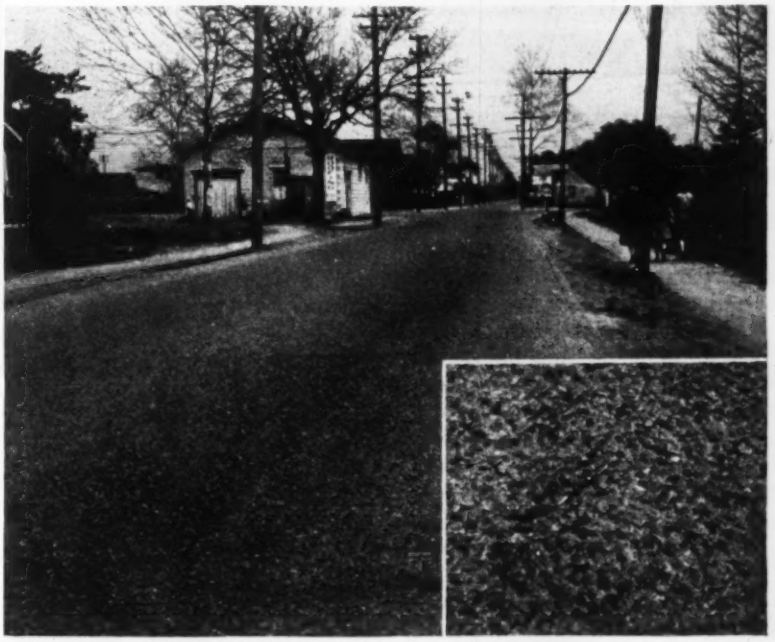


Fig. 2. Surfaced with asphalt and slag, the shell base construction makes a first-class pavement. The inset shows the rough texture of the surface.

Fig. 1. Spreading a 4-in. layer of oyster shells for a street repaving job in Jacksonville. After the shell is crushed with a roller and saturated with water, it forms a hard, cemented base.

The layers of shells are thoroughly crushed and compacted with a 10-ton three-wheel roller, in five or six passes. Before the final pass the surface is lightly bladed and thoroughly saturated before rolling.

The base is permitted to dry for 24 hours, after which it is given a prime coat with an oxidizing oil, either pine tar distillate or petroleum tar. This is applied at the rate of 0.2 gal. per sq.yd. and allowed to penetrate over a minimum period of 48 hours. Excess oil is blotted with clean sand before the surface coat is applied.

The wearing surface on this prepared base consists of asphalt oil applied with a pressure distributor at the rate of 0.40 gal. per sq.yd. and at a temperature of 400 deg.F.—over which is spread 45 to 50 lb. per sq.yd. of slag. Slag passing a ¾-in. ring is used for the surface metal.

These low-cost streets are said to have remarkable service qualities and require little maintenance. They provide a smooth, hard surface with good wear resistance under city traffic.

The work in Jacksonville is under the direction of W. E. Sheddan, city engineer. Walter D. Daniels is engineer of highways and sewers, and H. T. Broadstreet, assistant engineer, is in direct charge of field operations.

Building Lake Washington Pontoons

Contents in Brief—The concrete pontoon toll bridge at Seattle, 1¼ mi. long, is now in the construction stage with a production schedule calling for one 59x360-ft. pontoon to be launched from a special drydock every 15 days. Prefabricated form units are used.

A HIGHWAY BRIDGE 1¼ mi. long, consisting of concrete pontoons floating on Lake Washington at Seattle, Wash., is now under construction by the Washington Toll Bridge Authority as part of a highway relocation project that will save 14 mi. on the main route from Seattle eastward across the mountains. This route goes over Snoqualmie Pass, the most direct as well as the only all-year route across the Cascades in northern Washington. The project as a whole comprises 6½ mi. of new highway whose 11 schedules include a twin bore tunnel, 1,445 ft. long, several bridges or overpasses, and the pontoon bridge. The over-all cost of the project is to be $8,854,000 of which the floating bridge (Schedule 4) accounts for about $3,254,000. The pontoon contract, awarded Dec. 31, 1938, contemplates completion of the bridge July 1, 1940. (For artist's sketch of the movable span see *ENR*, Feb. 17, 1938, p. 248.)

The floating structure, consisting of 25 pontoons, will span the lake from the mainland to Mercer Island, 6,561 ft., on the direct route best suited to the 6½-mi. relocation. Deep water and adverse bottom conditions would have made piers expensive. A floating structure was favored, on the other hand, by the facts that the lake level is accurately controlled by ship locks, there is no current, no drift and no ice. The lake is pure, fresh water and the cost of the floating structure is one-fifth of what would be required for a bridge on piers.

The width of the floating roadway will be 45 ft. with a 4-ft. sidewalk on either side. Pontoons are 59 ft. by 350 ft. in plan with a 14½-ft. depth. They are designed for a 7-ft. freeboard but solid concrete railing will give an effective height of about 10 ft. from water surface to rail top. Adjacent pontoons will be bolted together to form a continuous, rigidly connected structure from either end to the draw opening at the ship channel.

Pontoon construction plan

Pontoons are being poured in two graving docks built expressly for this purpose near the southern end of Seattle's water front. The docks were built side by side where they can be supplied from the same concrete mixing plant and with space between for storing the wooden form units.

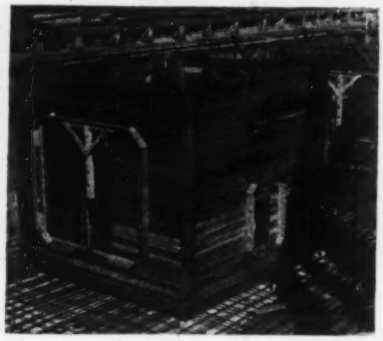


Fig. 1. One of the prefabricated form units, 14½ ft. square. Note reinforcing previously placed on floor of drydock.

Outer forms for the pontoons are built up inside the graving docks, reinforcing steel for bottom and outer walls is placed, and then wooden form units, assembled in the yard, are lifted bodily by the derrick and placed in the dock. In this way the central portion of each pontoon is formed as a cellular structure. The standard pontoon has four longitudinal rows of cellular spaces, 24 to the row, each 14½ ft. square. About 1,338 cu.yd. of concrete is required to make up the bottom, sides, and interior walls of a standard pontoon. The deck pour requires about 630 cu.yd. of concrete which is poured after the inside forms of the lower pour are removed. Railings and finishing touches in general are put on after the pontoon is floated out of the drydock. Under this plan the continuous pouring operation requires less than two days, after which the forms are allowed to stand 24 hr. before stripping the walls and five days before stripping the deck slab. Five days later the water is admitted to the dock and the pontoon hull is floated out.

Longitudinal and transverse walls divide the pontoon interiors into cells 14½ ft. square (the size of the assembled form units). Outer wall thicknesses are 8 in. and inner walls are 6 in. thick, all heavily reinforced. Reinforcing steel averages about 315 lb. per cu.yd. of concrete.

Prefabricated form units

A major feature of the construction program is use of pre-assembled form units erected in the yard adjoining the drydocks and set in place with the derricks. These forms are designed for easy removal, after concrete has set, by knocking out wedges and lifting out the unit in sections. These sections are cleaned, oiled, reassembled, and stored alongside the dock for repeated use. Openings in these form units facilitate inspecting reinforcing prior to pouring and give access to the corridors which connect certain of the cellular spaces.

A detail of importance in handling the form units is the method of setting them on exact grade and alignment. This is accomplished with the aid of four small truncated iron cones placed in the dock, after the reinforcing is laid, at the points where the four corners of the form unit are to land. At points midway beneath the four sides of each form unit, hydraulic jacks are placed each with a special mounting on its head consisting of two steel plates with a 17-ball race between. Heads of the jacks are set at 8½ in. above the floor of the drydock, or ¼ in. higher than the level of the four truncated cone tops.

With this arrangement the weight of the form unit is taken first by the

jacks. The ball-bearing heads permit movement of about 1 in. in any direction in a horizontal plane. This play makes it possible to exactly align the form unit in two directions, with the aid of transit instruments, whereupon the jacks are lowered ¼ in. allowing the form unit to rest upon the steel cones at the corners. These cones rest on concrete chairs to avoid carrying metal through the floor of the pontoon.

Concreting program

The concrete plant, designed for delivering 60 to 70 cu.yd. per hr., is at the water end of the yard between the two docks. Buckets of concrete are trucked to the derrick which operates along a track extending the full length of each dock. For convenient transverse distribution on the pontoon, a bridge was built to span the dock, movable along longitudinal rails. This bridge carries a 4-cu.yd. hopper to receive concrete from buckets delivered by the derrick. The hopper moves along tracks on the bridge discharging into elephant trunks, or 8-in. rubber hoses so located that all portions of the pontoon can be reached.

When concreting starts on a pontoon the pour is continued without intermission until the hull is complete, thus eliminating all construction joints. The total concrete in the standard size pontoon is 2,100 cu.yd.

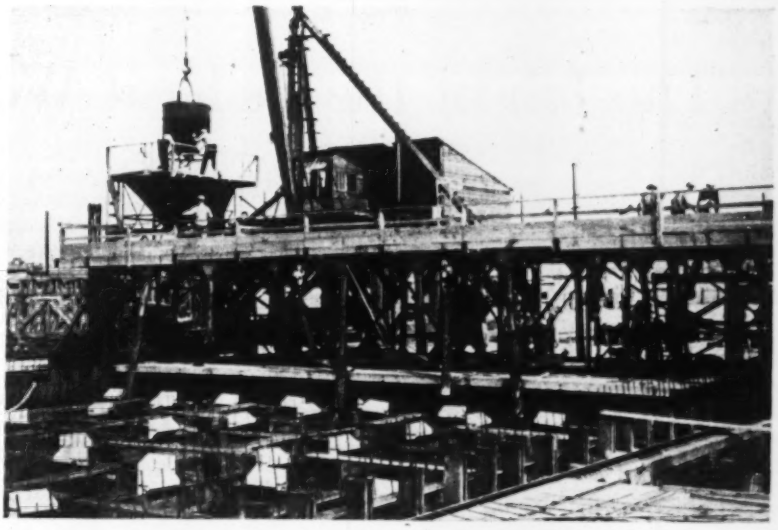


Fig. 3. A movable bridge (see rail in foreground) spans the drydock, receives concrete in a hopper that rolls along the bridge to any delivery point.

Bridge assembly

When the finished pontoons are towed into place for assembly, water ballast will be used in the process of alignment. Adjacent pontoons will be bolted up and grouted into a continuous, rigid structure. Each pontoon is to be anchored transversely by 2¾-in. steel cables, of which there are two to each pontoon, attached to adjustable connections inside the pontoon. Provision will be made for adjustment in length of the cables by jacks, as necessary.

Three types of anchors are planned: (1) on hard bottom a steel pile anchor assembly with eyebar connection; (2) for medium hard bottom a reinforced concrete box sunk to place and filled with concrete through tremies; and (3) in soft bottom precast anchors with reinforced concrete shanks and palms, fitted with jet pipes so they can be thoroughly bedded down in the mud.

The 378-ft. pontoon that will be a floating draw span will give a clear channel opening 200 ft. wide. It will be opened by telescoping into the adjacent fixed pontoon, which is built on a Y-plan for the purpose, the roadway splitting and following the forks of the Y around the opening. The operating machinery will be carried by the fixed pontoon.

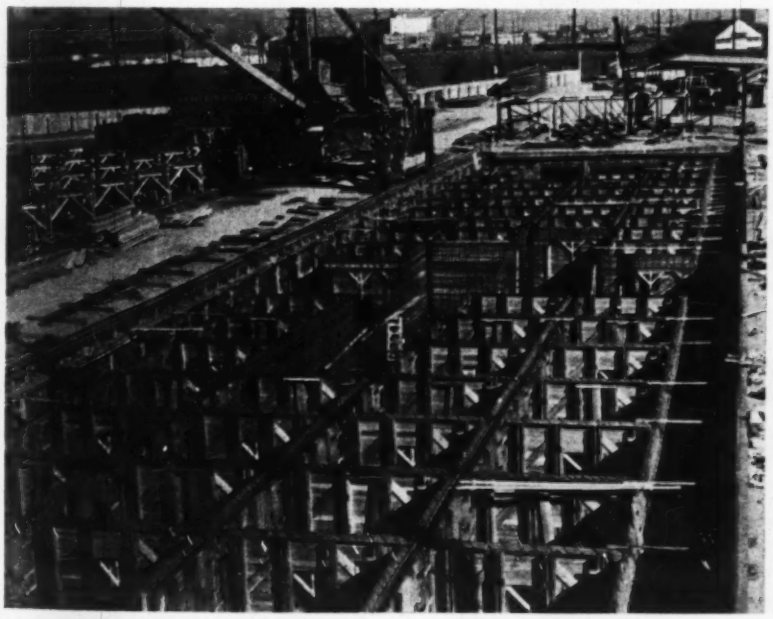


Fig. 2. Assembled form units have been lifted by the derrick from storage space at left into the drydock.

Direction

The Lake Washington Bridge is being constructed by the Washington Toll Bridge Authority; Lacey V. Murrow, chief engineer; R. M. Murray, bridge engineer; Chas. E. Andrew, principal consulting engineer. The consulting board consists of Chas. E. Andrew, chairman, R. B. McMinn, R. H. Thomson and L. E. Gregory. The contract for the pontoons is held by a combination of four firms, namely, the Puget Sound Bridge and Dredge Co.; J. H. Pomeroy & Co., Inc.; Parker-Schram Co.; and Clyde W. Wood. Completion date for the pontoons is June 13, 1940.

The Job of the Federal Works Agency

JOHN M. CARMODY
Administrator, Federal Works Agency, Washington, D. C.

Contents in Brief—The new administrator of the month-old unified construction branch of the federal government describes the work to be done by each of the five subdivisions, reveals plans to provide the construction industry with information on works programs that will aid scheduling of work and employment and promises minimum change in the personnel and policies of the existing organizations that are being welded into a Federal Works Agency.

IN CARRYING out the purposes of the Reorganization Act of 1939, the President, in Reorganization Plan 1 found it desirable to group under a Federal Works Agency "those agencies of the Federal Government dealing with public works not incidental to the normal work of other departments, and which administer Federal grants or loans to state and local governments for the purposes of construction."

In accordance with Plan No. 1 the following agencies were grouped under the new Federal Works Agency:

(1) The Work Projects Administration (formerly the Works Progress Administration). This agency carries forward a wide range of projects proposed primarily by state and local agencies. At least 95 per cent of the persons employed upon these projects must be persons who are certified as in need of relief. The sum of $1,427,000,000 was recently made available to WPA for its program in the fiscal year 1940. Colonel F. C. Harrington is its commissioner.

(2) The Public Works Administration (formerly the Federal Emergency Administration of Public Works). This agency is completing its fiscal 1938 program and at present has no funds available for further projects. It finances by means of loans and grants to public bodies the construction of such projects as school buildings, waterworks, sewer systems, hospitals, bridges, power and reclamation systems, and city halls. Grants have usually been made of 45 per cent of the approved cost of the project. Colonel E. W. Clark is the acting commissioner.

(3) The United States Housing Authority. This agency has as its major purpose the administering of grants-in-aid and loans to local public housing authorities for construction in that part of the housing field which private enterprise has been unable to reach with profit. This agency is engaged in an $800,000,000 housing program, and all of its funds have been earmarked. Nathan Straus is its administrator.

(4) The Public Roads Administration (formerly the Bureau of Public Roads of the Department of Agriculture). This administration, headed by Thomas H. MacDonald as commissioner, manages the federal roads program with its grants to the states.

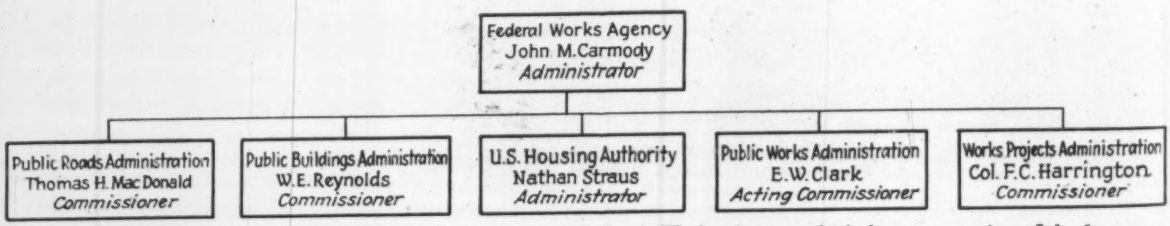
(5) The Public Buildings Administration. In this are combined the buildings branch of the Procurement Division of the Department of the Treasury, the branch of buildings management of the National Park Service of the Department of the Interior, and that part of the National Park Service in the District of Columbia relating to the general assignment of space to federal agencies, the selection of sites for public buildings and the determination of the priority in which the construction or enlargement of public buildings shall be undertaken. Among the large federal structures whose construction is being undertaken by this new administration in Washington are the new Social Security Building and the new building for the War Department. W. E. Reynolds heads this new unit as commissioner.

The statute provides that the federal works administrator "shall have general direction and supervision over the administration" of the five agencies listed above and "shall be responsible for the coordination of their functions."

No one who has not come into close contact with the operations of one or more of these agencies can appreciate the scope of their operations or comprehend the many diffi-

DISTRIBUTION OF PERSONNEL IN UNITS OF FEDERAL WORKS AGENCY

	Washington	Field	Total
Works Projects Administration	1,768	30,443	32,211
Public Works Administration	2,581	8,203	10,784
Public Buildings Administration	6,950	2,029	8,979
Public Roads Administration	756	1,832	2,588
United States Housing Authority	1,488	608	2,093
Totals	13,543	43,115	56,658



Organization setup and directing heads of the new Federal Works Agency which began operations July 1.

cult and delicate problems which must be faced and solved in coordinating their programs and operations so as to weld them into an effective national program of public works. This comprehensive program should be geared to meet the demands of our national economy.

I do not plan at this time to build a large top or overhead organization to duplicate work now being done by the organizations making up the Federal Works Agency. The constituent organizations are headed by experienced and capable men. We can accomplish more in economy and effective coordination by closely knit cooperation at the top than by scattering our shots.

Our first job, of course, is to put on paper all of the facts about all of the programs. By translating dollars into payroll hours and units of materials we will be able to see quickly what the total volume is month by month, and how it is spread geographically. We want the broad picture without detail that will swamp us. We are doing this not merely to enable us to work out a coordinated program for ourselves but, more importantly, to enable us to give to all of the industries that operate in the construction field and benefit from these programs the information that will enable them to plan their own operations and their employment intelligently.

Later on, of course, in cooperation with the National Resources Planning Board, other agencies of government concerned with economic planning and representatives of industry in the broad field of construction, we hope to take the long look ahead that advocates of a coordinated department of public works have dreamed of and talked about for twenty years.

Our programs will provide profitable employment for architects, engineers, contractors, and equipment and materials men, and we shall at all times welcome their cooperation. Our job is one of enriching American life through enabling our communities to build attractive public works which will raise the standard of living of their citizens. We shall put idle capital to work so that it will provide employment and stimulate the industrial and commercial enterprises of this nation.

As this is being written, two major pieces of national legislation of tremendous importance to the public works program of the Federal Works Agency are under consideration by the Congress. The Self-liquidating Projects Act of 1939, if enacted in its present form, will make $750,000,000 available to the Public Roads Administration for toll express roads and toll bridges and $350,000,000 to the Public Works Administration for loans for public works. An amendment to the United States Housing Act of 1937, authorizes the United States Housing Authority to issue an additional $800,000,000 of its own bonds to provide funds for extending its housing program.

The enactment of these two measures will add substantially to the activities and profits of the construction industry in the United States.

Earthfill Slope Protection

UNUSUAL CARE was taken to prevent erosion on the slope of an earthfill dam at the forebay of the Stanislaus power plant in California owned by the Pacific Gas and Electric Co. The slope is steep (1¾ to 1), the material is light and occasionally there is heavy rainfall, all of which contribute to the importance of making effective protection against erosion.

This was done by building channels that would convey the runoff from rain and melting snow to the ends of the structure thus preventing water from flowing down the slope. The channels were formed by driving 4x6-in. redwood posts as supports for 2-in. redwood plank-runs along the surface of the dam. Workmen with shovels filled in earth behind the boards, and sprinkling and tamping aided in forming channels with relatively impervious side slopes. The result has been that in some 30 years of operation there has been no washing of the slope.

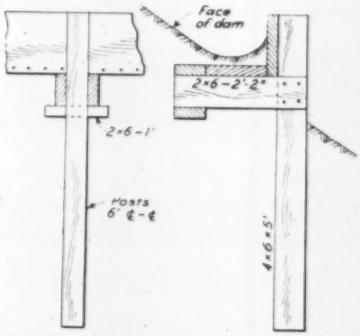


Fig. 2. Details of plank and post construction for runoff channels.

Fig. 1. Vertical boards insure safe runoff of surface drainage on this steep earthfill slope of a dam in California.

Erosion Control on a Road Fill

Contents in Brief—Contour ridges of stakes and wattles check wash of several fill slopes on a Missouri highway. Construction costs only half as much as full sodding.

A METHOD of erosion control found to be about half as costly as full sodding and particularly suitable to infertile subsoil fill slopes is shown by the accompanying illustration. The work is a part of erosion-control operations in St. Louis County, Missouri, and embraces 34 slope acres of fill. Incidentally full sodding was recently employed on about 5½ acres of cut and fill slopes at grade separations from which the comparative costs given in the accompanying tabulation were obtained. All the work was done by hand labor using WPA work-relief labor, and this has to be allowed for in considering the costs given. These and the description of methods are taken from a report by C. C. Tevis, Missouri state highway department.

Making the contour ridges

Referring to the illustration, the first operation was to smooth the fill slope, which was badly rutted by surface drainage. The erosion-control operations proper consisted of first driving rows of stakes along the slopes on 2- to 3-ft. contours. The stakes were of oak 2x2x30 in. and were driven vertically 2 ft. apart in the row. The driving was done by hand. After driving, the stakes projected about 6 in. Upslope from each row a 12x12-in. ditch was dug and filled with wattles of twisted hay. A small amount of earth was shoveled over the hay and the ground between the hay wattles was loosened to encourage growth. The final operation was to seed the entire slope and cover it with enough hay to hold the seed in place. Fig. 1 shows the slope complete and its condition after several heavy rains.

UNIT COSTS OF EROSION CONTROL ON CUT AND FILL SLOPES ON A MISSOURI HIGHWAY

Item of work	No. of Units	State Cost	WPA Cost	Total Cost
Sodding in place, sq.yd.	26,801	$0.01	$0.19	$0.20
Sloping, acre	34	$14.95	$272.25	$287.[illegible]
Erosion control, sq.yd.	47,404	$0.003	$0.097	$0.10
Seeding and strawing, acre	34	$11.42	$142.25	$153.67

The costs of the several items of work are given in the accompanying table; state costs consist of engineering, equipment rental and some miscellaneous items; WPA costs are labor, materials and some equipment rental.

The figures on full sodding are included for comparison. Full sodding was done on the slopes at five grade separations, one of which is shown by Fig. 2. Commenting on the two methods, the report points out that sodding requires a fertile soil under the sod or one sufficiently treated with fertilizer to produce a healthy growth. The erosion protection has proved satisfactory with all types of soil.

Fig. 1. Completed erosion control on a fill slope found to cost about half as much as full sodding and to be successful on all types of soil.

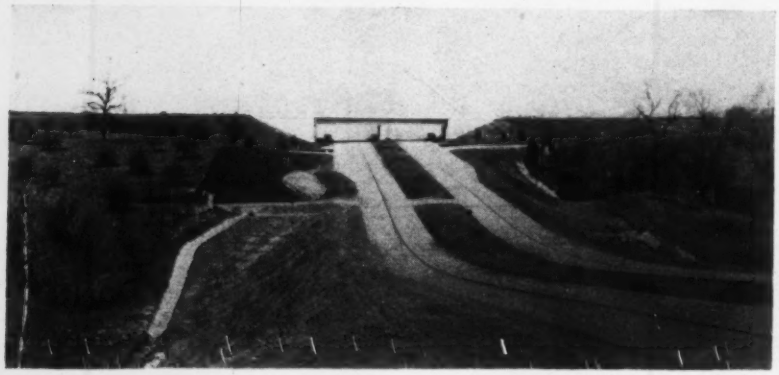


Fig. 2. Full sodding and landscaping used on cut and fill slopes at five grade separations.

Expenditure of Wages On WPA Projects Analyzed

Of every dollar paid in wages to construction workers on PWA projects, 32 cents is expended for food, 11 cents for clothing, and 16 cents for housing, according to a study completed by the Bureau of Labor Statistics of the U. S. Department of Labor. Other expenditure classifications include 12 per cent for household operation, 4 per cent for furnishings and equipment, 9 per cent for transportation, 5 per cent for recreation, 4 per cent for medical care and 7 per cent for a variety of miscellaneous items.

Since 1933, a total of $1,205,452,000 has been paid out in wages by private contractors on PWA project construction sites, the report shows.

FIG. 1. PLANT SETUP FOR SINKING THE QUEENS ANCHORAGE AND TOWER CAISSONS FOR THE BRONX-WHITESTONE BRIDGE.

Deep Caisson Work at the Whitestone Bridge

GEORGE L. FREEMAN
Moran, Proctor & Freeman, Consulting Engineers, New York, N. Y.

Contents in Brief—Foundations for New York suspension bridge include square, rectangular and circular concrete caissons and square hollow-wall welded steel box caissons, the latter designed to float until cutting edge was at a 100-ft. depth. One of the circular caissons is founded 170 ft. below ground surface, deepest in the East. Vertical jetting wells and horizontal jetting nozzles in walls aided caisson sinking through difficult material. Vertical wells also used to admit drills and blasting materials when cleaning off disintegrated bedrock.

THE DEEPEST CAISSONS ever sunk for a bridge foundation east of the Mississippi River were required for the Bronx-Whitestone Bridge, which was opened for traffic at New York City on May 29. Besides the depth to which the caissons had to penetrate some of them had to be designed for unusually deep flotation and, for all, special provisions were adopted to facilitate sinking and the preparation of bearing surfaces on bedrock. General technical data regarding the new bridge are summarized in the appendix which follows and discussion here is confined to the substructure and particularly to the caisson foundations. Fig. 3 indicates the number and location of these foundations.

Borings at the piers and anchorages encountered sound bedrock at depths of from 70 to 168 ft. At the Bronx anchorage the ground surface is 4 to 6 ft. above datum (mean high high water), and the underlying soil is a compact sand and gravel with occasional boulders, changing to sand, with bedrock about 65 ft. below datum. At the Bronx tower, at about the low water line, the soil is similar to that at the Bronx anchorage, excepting for a bed of plastic clay from El. —50 to —60. In the upper 25 or 30 ft. are small boulders. Ledge rock is at a fairly uniform level at about —94 to —98.

The Queens tower pier is about 900 ft. from the Queens shore. The river bottom is at —14 to —16, with soft and unstable silt extending down to —102 to —104, where there is a 2 to 4-ft. layer of peat. Below the peat are interbedded sands and gravels, with occasional small boulders, and sound bedrock at —142 to —150. The Queens anchorage is near the south shore where there was originally 10 to 12 ft. of water with soft silt to a maximum depth of about 30 ft., and below the layers of sand, gravel, boulders and clay, the latter in a 20-ft.-thick sloping bed between El. —50 and —70. Bedrock at this point varies from —150 to —164.

The non-uniformity of the soil and the presence of low-lying compressible soil layers required the founding of the supports for the Queens anchorage and the main tower piers on bedrock. Under the Bronx anchorage, however, no compressible soil was found, and this structure was supported on the compact sand and gravel found at shallow depths.

Bronx tower caissons

Heavily reinforced concrete caissons with wall dimensions as shown by Fig. 4, were adopted for the Bronx

Fig. 2. The 2,300-ft. main span of the Bronx-Whitestone Bridge is the fourth longest in the world. Towers devoid of cross bracing and anchorages shaped to the cable profile are other features.

tower. Vertical wells, 8 in. in diameter, about 6 ft. on centers, were constructed in all walls. Through these wells high-pressure jet pipes and churn drills were operated to remove boulders or other materials obstructing the progress of the sinking, and also to remove disintegrated schist overlying the sound rock.

As a further aid to sinking, the contractor was required to provide lubricating jets (Fig. 4) at 10 and 35 ft. above the cutting edges, the nozzles in each row to be spaced not more than 8 ft. on centers, with spacing in the two rows staggered. The specifications required that water should be delivered to groups of jet nozzles at not less than 200 lb. per sq. in. pressure; the contractor provided 6-in. supply risers, each connected to four lubricating jets and controlled by valves at the top. Further requirements were high-pressure pumps supplying water to independent jet pipes, to be operated within the dredging wells or through the 8-in. vertical wells, the pumps to supply water at 300 lb. per sq. in. to 1-in. jet nozzles.

The Bronx tower piers being near the shore line, the contractor elected to construct them as a land job, working on an area filled around the caissons. Prior to making the working fill, the site of the caissons was predredged about 25 ft. deep to remove boulder-bearing material. Steel cutting edges were erected on blocking supported directly on the fill, and forms and concrete were constructed above the water level, except for the final lifts which were constructed within cofferdams. Dredging and the handling of forms and reinforcing were done with a stiff-leg derrick assisted at times by crawler cranes. Through much of the depth, the soil was so tight that the dredging wells were unwatered and the excavated material was loaded into buckets by hand. The bottoms of both caissons were prepared by hand, working in the dry, and the concrete seals to about 31 ft. above the cutting edge were placed in the dry. The dredge wells above the seals were left filled with water.

Queens tower caissons

At the Queens tower, the water was 14 to 16 ft. deep, and the mud extended to nearly 100 ft. below datum. Laboratory analyses of undisturbed soil from a depth of 75 to 80 ft. showed about 2¾ parts of water to one part of solids by volume. It was evident that caissons in this location must float to a great depth before reaching a material of sufficient strength to support their weight. The caissons (Fig. 4) were designed as hollow walled steel boxes, capable of supporting the concrete filling by flotation until the cutting edges landed on firm materials at El. —100.

To a depth of 16 ft. below the surface the steel shells were designed for flotation in open seawater; from that level to 34 ft. below the surface in a semi-fluid mud weighing 95 lb. per cu. ft.; then to a depth of 72 ft. in a stiffer mud, having a combined weight and supporting capacity equivalent to a fluid weighing 126 lb. per cu. ft.; and to El. —100 in a stiff mud equivalent in weight and supporting capacity to a fluid weighing 157 lb.

TABLE 1 — CAISSON WEIGHTS TO OVERCOME FRICTION

Caisson Nos.	Cu. yd. concrete per vert. ft.	Sq. ft. skin per vert. ft.	Submerged weight per sq. ft. of skin
1 and 2	34	134	590 lb.
3 and 4	34 and steel	134	633 lb.
5 and 6	74	257.4	670 lb.
7 and 8	12	75.4	370 lb.

TABLE 2 — SINKING RATES OF WHITESTONE CAISSONS

Caisson No.	Size ft.	Distance sunk ft.	8-hr. shifts actually worked	Sunk in 1 shift, ft.	Sunk in 3 shifts, ft.
1 Bronx tower	38 x 38	102.6	246	0.42	1.26
2 " "	38 x 38	98.4	264	0.37	1.12
3 Queens tower	38 x 38	135.7	271	0.50	1.51
4 " "	38 x 38	139.4	297	0.47	1.41
5 Queens anchorage, front	33 x 100	151.9	577	0.26	0.79
6 " " "	33 x 100	157.6	620	0.25	0.76
7 Queens anchorage, rear	24 dia.	162.2	334	0.49	1.46
8 " " "	24 dia.	151.1	269	0.56	1.69

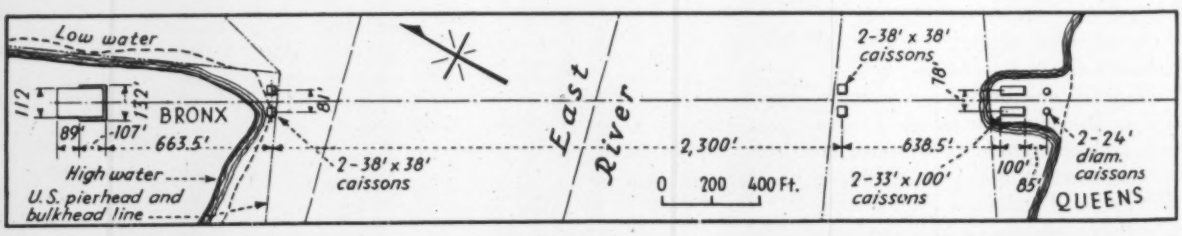


Fig. 3. Plan of Bronx-Whitestone Bridge indicating the several shapes of foundations required and their locations.

per cu. ft. It was expected, and found, that the material at El. —100 offered sufficient support so that flotation was no longer required, but the hollow-walled structure was extended up an additional 10 ft. to guard against overtopping by high tides and waves.

The two floating caissons were built at Wilmington, Del., of all-welded construction. The cutting edge units, 21 ft. high and drawing about 7 ft. of water, were launched at Wilmington and towed to the bridge site where they were held in position by timber and wood pile guide frames constructed prior to their arrival. The remaining parts were fabricated in units 10½ ft. high and shipped to the work on barges. Field erection consisted in lifting the caisson sections from the barges, setting them on top of the floating caissons and welding the splice members and the vertical and horizontal joints. The total weight of structural work in each caisson was 396 tons.

Maintaining the floating caissons in correct position while sinking in the soft mud required constant vigilance on the part of the sinking crew, whose tendency was to add concrete and let the mud rise high in the dredge wells. At times the mud would form plugs at the bottoms of the wells and further sinking, without dredging, would result in displacement of the mud, with a strong tendency for the caissons to skid sideways. When the cutting edge of Caisson 3 was at El. —48, the caisson moved nearly 2 ft. to the north while adding a lift of concrete, and its position was not wholly corrected at the final landing level 142 ft. below datum.

Except for the use of a floating crane in placing the structural steel caisson sections, dredging and other work was handled with a stiff-leg derrick on a work dock erected alongside the pier site and connected to the south shore by a timber pile trestle about 600 ft. long (Fig. 1). After the preparation of the bottoms, the concrete seals were placed by submarine buckets. Dredge wells above the tops of the seals were left filled with water.

Queens anchorage caissons

The four caissons at the Queens anchorage were constructed from a permanent fill, brought up to El. +6 and of sufficient area to provide working room for construction plant and materials. The fill was advanced at full height from the shore outward, so as to displace as much soft mud as possible, which had a depth at the outer edge of the fill of 35 ft. Subsequent caisson excavation indicated that practically all of the soft material had been pushed aside.

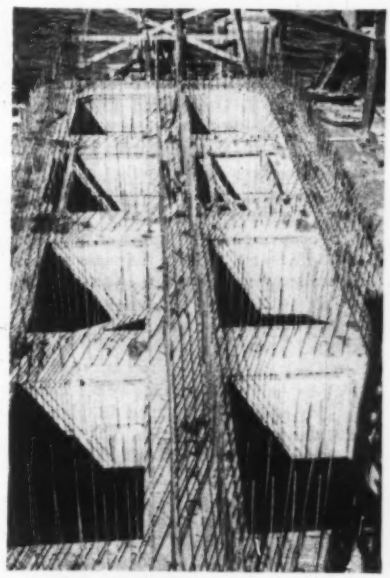


Fig. 5. Long caissons for the Queens anchorage gave the greatest trouble in sinking.

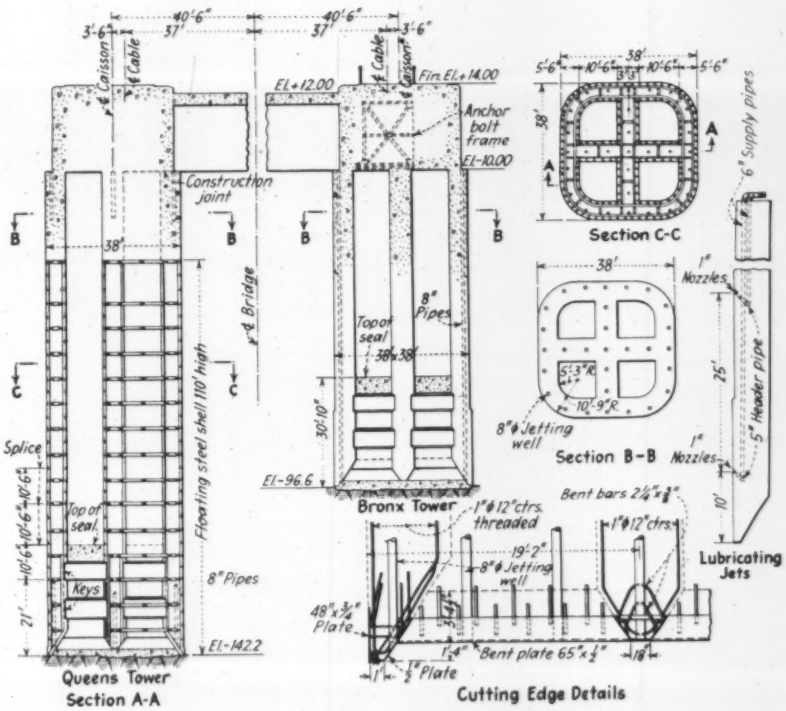


Fig. 4. Conditions called for a different design of caisson for each tower; steel caissons were designed for 100-ft. flotation; jetting wells and the lubricating jets which were placed in the walls of the caissons deserve notice.

Anchorage caissons 5 and 6 (Fig. 3) 33x100 ft., were of reinforced concrete, with exterior and interior walls 5 ft. thick, and were provided with heavy steel cutting edges. Access wells (8 in.), rounded corners and lubricating jets were provided as for the tower caissons. The four northerly dredge wells of each caisson were sealed with concrete to a depth of about 40 ft. above the cutting edge, and the remaining height left filled with water. The six southerly dredge wells, located directly under the supported anchor block, were completely filled with concrete to the tops of the caissons at El. +5, the upper 30 ft. being placed in the dry and the concrete below that by submarine buckets. Caisson No. 5 was landed with the cutting edge at El. —145, the lowest level of rock excavation being —158. Caisson No. 6 was sunk to El. —152 with lowest rock excavation at —163.4.

The two rear supports under the Queens anchorage were circular caissons 24 ft. in outside diameter, with central dredge wells 12 ft. in diameter, and walls of reinforced concrete 6 ft. thick. The bottoms were sealed with concrete to a height of 40 ft. above the cutting edges, the remaining height of the wells being left

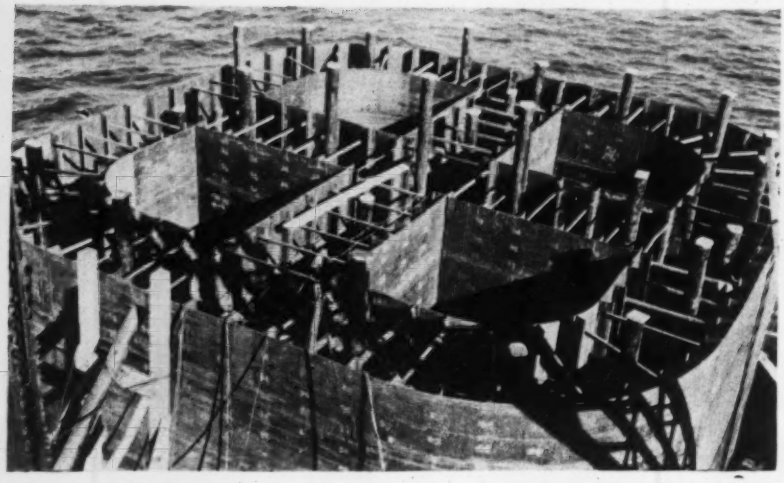


Fig. 6. Top of hollow-wall steel caisson used for Queens tower pier and designed for 100-ft. flotation.

filled with water; 8-in. wells and lubrication jets were provided. The cutting edge of caisson 7 was landed at El. —156 and of caisson 8 at —145. The lowest excavation was in caisson 7, where rock was excavated to El. —164, or 170 ft. below the level of the working fill on which the cutting edges were laid. This is believed to be the deepest caisson excavation east of the Mississippi River.

Data on sinking

Dredging and sinking were difficult, except at caissons 3 and 4, because of the compact sand and gravel, beds of tough clay and occasional boulders. When heavy toothed dredging buckets failed to dislodge such materials, the contractor was forced to break them up with heavy chopping bits, high pressure jets and at times with dynamite. The 8-in. vertical wells in the walls were life savers for the contractor, who used them frequently to drill or jet during the removal of materials under the cutting edges beyond the reach of the dredging buckets. They were particularly useful for drilling and loading holes when it became necessary to blast disintegrated schist and ledge rock from under the walls in the final sinking stages. From 10 to 20 ft. of schist was removed by such blasting before reaching satisfactory bearing rock under the several caissons.

No determinations could be made of the skin friction developed during sinking, but the weights of the caissons, aided by the lubricating jets, were sufficient to induce sinking when the cutting edges were not bearing on the soil. The actual weights, allowing for buoyancy, available to overcome skin friction were as shown in Table 1.

Long and narrow caissons are usually difficult to guide, and Nos. 5 and 6 at the Queens anchorage were no exceptions to the rule. To add to this difficulty, the contractor, because of contract-time limitations, elected to sink the two caissons simultaneously, alternately dredging and building up on each as sinking progressed. By the time the cutting edges were 100 ft. in the ground both caissons had encountered hard going, blow-ins had occurred and the prism of soil between the caissons, with a width of only 45 ft. and a length and depth of about 100 ft., was thoroughly disturbed. The caissons leaned toward each other at the tops, and efforts to right them were futile. When finally landed, caisson No. 5 leaned 2.45 ft. east at the top, and No. 6 2.44 ft. west, in a height of about 150 ft. The specified tolerances of 2 ft. were exceeded but, fortunately, the inclinations were equal and opposite, and stresses were balanced and within safe limits. The average daily sinking rates are shown in Table 2 where the

TECHNICAL DATA ON THE BRONX-WHITESTONE BRIDGE

Location—The Bronx-Whitestone Bridge is the latest completed long-span bridge link in the great express highway system of New York City. It connects the boroughs of Bronx and Queens across the East River and thus gives northern New York City direct access to the parkway system and connecting roads of Long Island.

Type and Dimensions—The Bronx-Whitestone Bridge is a wire-cable suspension bridge with the fourth longest suspension span in the world, its river span of 2,300 ft. being exceeded in New York by the 3,500-ft. George Washington bridge and in San Francisco by the 4,200-ft. span of the Golden Gate Bridge and the 2,310-ft. spans of the San Francisco-Oakland Bay Bridge. When the 2,800-ft. span of the Puget Sound Bridge at Tacoma Narrows is completed the Bronx-Whitestone span will become fifth in order of length. The East River at the Bronx-Whitestone location is 3,300 ft. wide between shores and 2,250 ft. between bulkhead lines.

In addition to its main span of 2,300 ft. the bridge has two 735-ft. side spans which with the approach viaduct spans bring its total length to 4,015 ft. The approaches are plate girders on concrete piers and are 1,620 ft. long in Queens and 2,300 ft. long in the Bronx. The river span has a clearance of 150 ft. at the center. The width between centers of cables is 74 ft. divided into two 6½-ft. sidewalks and two 27½-ft. roadways, with center and side curbs occupying the remainder of the space. The width-length ratio of the main span is the smallest yet utilized on a large bridge, and necessitated special structural details in the wind truss to achieve the necessary rigidity.

Towers and Anchorages—The anchorages are concrete, U-shaped in plan and triangular in side elevation, 110 ft. wide, 150 ft. long and 110 ft. high. That at the Bronx end is founded on natural soil at a depth of 16 to 21 ft. and that at the Queens end on four caissons sunk to rock. The towers are elastic steel frames consisting of T-section plate steel shafts tied together by a heavy portal at the top and another just below the bridge deck. They rise 377 ft. above mean high water. Across the bridge the tower shafts are 16 ft. wide, and parallel to the bridge they taper from 18 to 12 ft. wide. The portals have a rectangular box section 7 ft. wide and 23 ft. deep at the center.

Cables and Suspenders—The parallel-wire cables are 22 in. in finished diameter and have a net sectional area of wire of 297 sq. in. The sag of the cables is 200 ft. The suspenders consist of two 2-in. wire ropes looped over the cable bands and attached to 11-ft. plate stiffening girders to which the floorbeams are riveted. The wind truss is hinged at towers and anchorages and has a width of 74 ft. between stiffening girders.

Design Loads—The average dead load is 10,950 lb. per ft. for the center span and 10,780 lb. per ft. for the side spans. The towers weigh about 3,500 tons each. The live load was assumed as 8,000 lb. per ft. for the suspenders and as 3,000 lb. per ft. for all other parts. The wind load at 30 lb. per sq. ft. was estimated at 800 lb. per ft. of bridge acting on the floor, 120 lb. per lin. ft. on both cables and 5,500 lb. per ft. of height of each tower.

slow progress for caissons 5 and 6 reflects the difficulties described above.

Unit foundation loads

Under conditions of maximum loading the rock under the Bronx tower pier is loaded to 22 tons per sq. ft. and under the Queens tower pier to 24 tons per sq. ft. With full cable pull, the pressure under the forward ends of the Queens anchorage caissons 5 and 6 ranges from 43 to 55 tons per sq. ft., depending upon the degree of buoyancy of the caissons and the actual area of rock loaded. The rear caissons, 7 and 8, were temporarily loaded, during the construction of the anchorage block and without any cable pull, to about 58 tons per sq. ft.

Durable concrete

Sulfate-resistant portland cement was used throughout the work, the specifications requiring 6 sacks per yard of concrete with a maximum of 5¼ to 6 gal. of water per sack of cement for concrete exposed directly to seawater. Reinforcing steel was kept 6 in. from exposed surfaces and all concrete was vibrated.

Engineers and contractors

The contract for the tower and anchorage foundations was awarded to Frederick Snare Corp., New York City, the total cost being about $1,860,000; it was dated June 9, 1937, and work was completed on July 8, 1938.

Corbetta Construction Co., Inc., New York City, had the contract for the anchorages and approach piers, and the American Bridge Co., New York City, the contract for the superstructure and cables. The Bronx-Whitestone Bridge was built by the Triborough Bridge Authority under the direction of Robert Moses, chairman. O. H. Ammann was chief engineer for the authority. Moran, Proctor & Freeman were consulting engineers on the foundation work, and furnished designs and general supervision for the main span foundations.

Madigan-Hyland, consulting engineers, supervised construction operations, with H. W. Hudson in direct charge of the work. The steel shells for the floating caissons of the Queens tower pier were fabricated by the Dravo Corp. at its Wilmington, Del. plant.

Four-Year Maintenance Cost On Timber-and-Concrete Viaducts

FOUR YEARS of maintenance and repair history is now available for the "composite construction" used by the Oregon state highway commission on the Fourth Ave. viaducts in Portland, Ore. This type of composite construction involves the integration of timber stringers with a concrete deck slab by means of shear connections consisting of a combination of spikes and daps. The bridges in question also utilized prefabricated timber tower bents, some as much as 96 ft. high. Although this type of construction has been considered frequently in other regions where timber is commonly used for highway structures, lack of information as to maintenance costs has militated against a more extensive use. G. S. Paxson, bridge engineer of the Oregon state highway commission, was asked to supply the maintenance record to date on the Fourth Ave. viaducts which were described in *Engineering News-Record*, Oct. 4, 1934, p. 429. The following has been taken from Mr. Paxson's notes.

Of these two viaducts, the shorter one (Newberry St.) which is 377 ft. long, has a maintenance cost slightly less than the other (Vermont St.) because of a "surface drainage" item on the latter amounting to some $84. This item was in reality an expenditure for betterment; if it is subtracted from the total charges the annual maintenance cost per foot is practically the same for the two structures.

Both viaducts have roadways 48 ft. wide with two 3½-ft. sidewalks. They were built in 1934 and opened to traffic early in 1935. Total maintenance and repair costs appear in the table.

Cost Record for the Fourth Ave. Viaducts, Portland, Ore.

	Newberry St. (dollars)	Vermont St. (dollars)
Total construction cost	50,025.29	63,650.01
Average construction cost per lin. ft.	132.90	126.60
Restain and varnish timber handrails	144.50	191.00
Welding expansion joint plates	9.00	.....
Rockwork for surface drainage	.....	84.18
Tighten bolts	78.42	103.27
Total maintenance	231.93	378.45
Maintenance per year	57.93	94.61
Average maintenance per lin. ft.	0.154	0.19

On both structures more than half the expenditure during the four-year life has been on the handrails, work done primarily to improve appearance. The tightening of bolts is part of routine attention that timber trestles should get every three or four years. The only structural maintenance, *per se*, was in the welding of the steel expansion joint plates which worked loose under traffic.

In summing up observation of the two structures Mr. Paxson states, "It is to be expected that the maintenance cost will be heavier with advancing age, but as yet we have had no evidence of any serious deterioration which would indicate high maintenance cost in the near future."

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Penny Parking Meters Grow in Popularity

Complaints by motorists in cities with parking meters that they must pay for a full hour's privilege when they park for only a few minutes have led many cities to install penny meters, the American Municipal Association reports. The penny meters allow for as low as 12 minutes' parking time.

In Salt Lake City, Utah, where 2,000 parking meters recently were installed in the business district, motorists may insert either penny or nickel coins. One to four pennies will buy from 12 to 48 minutes' parking time. One nickel will buy an hour's time. If the motorist plans to shop for more than an hour, or attend a movie, two nickels may be inserted into the meter.

The same procedure may be followed in Auburn, N.Y., and Fredericksburg and Lynchburg, Va., where penny meters have been installed recently; also in Atlantic City, N. J., and other cities where nickel meters have been altered to provide penny parking.

Thickened-Edge Pavements A Failure

W. S. Downs

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Contents in Brief—Based on his careful inspection of thousands of miles of pavement during the past five years, the author classes the thickened-edge pavement as a design failure. Uniformly thick pavements promise longer life and better service.

THE MATERIALS which enter into pavements are no less durable and often are of better quality than similar materials used in dams and bridges, yet bridges and dams endure for generations without failure, while it is doubtful if the average service life of highway pavements is more than 20 years. Engineers might well ponder why a concrete pavement should not render efficient service as long as a concrete bridge provided both are designed equally well to resist stresses due to load and temperature conditions. The time is past, if it ever existed, when it was sound economy to design high-type pavements for less than the maximum service life on a presumption that they will become obsolete before it is otherwise necessary to replace them.

Since Clifford Older with his corner formula and H. M. Westergaard with his stress analysis pointed the way to an adequate basis for design of concrete pavements, forty-one states have adopted the so-called thickened edge or "balanced design." This design assumes the pavement to consist of slabs of definite dimensions, separated by predetermined expansion or contraction joints. In practically all cases the width of the slab is that of a traffic lane, usually 10 or 12 ft. The length varies, from 20 to 30 ft. and is often more.

To determine thickness, the slabs are analyzed for stresses, considering the so-called protected and unprotected corners. In the case of a protected corner, where there is an adjoining slab, edge shear bars or some other suitable devices are employed to carry a portion of the wheel load to an adjacent slab, resulting in a corresponding reduction of stress. In the case of an unprotected corner where no such means can be employed, the slab acts alone and the corners must be capable of carrying the full wheel load. Since all the corners along the outer edge of the slab are considered unprotected, that edge is designed with the maximum thickness, usually from 8 to 10 in. The inside edges which adjoin other slabs are usually reduced in thickness to about seven-tenths that of the outer edge on the assumption that shear bars or other devices will be used, and that as much as 50 per cent of the wheel load may be effectively transferred to an adjoining slab.

This so-called balanced design is efficient only to the extent that all of the many assumptions which have been made with respect to the strength of concrete, shear-bar performance, subgrade reaction, static wheel load, impact, internal stresses and other presumptions are correct. If the slab develops unexpected cracks where shear support has not been made available it is obvious that the edges at the crack will be unprotected, depending upon the amount of separation. If there is no shear-resistance at these crack-edges and the thickness of concrete is only seven-tenths that at the outer edge, the load supporting power is only one-half that at the outer edge. Hence, if the outer edge was designed for a wheel load of 8,000 lb., by the same principles of design these newly formed crack-edges have a supporting power of only 4,000 lb.

That concrete slabs frequently crack is apparent to the casual observer. That there is no effective shear resistance between broken slabs often may be observed from the width of the crack and the slab performance. These conditions indicate clearly why many concrete roads have an unexpectedly short service life. After the slabs crack, destructive action progresses at a rapid rate because the so-called balanced design actually becomes "unbalanced." The pavement that was theoretically safe for the maximum wheel load becomes equally safe for only a part of that load. It is, therefore, doubtful, considering all things, if there is any true economy in the present use of the thickened-edge design. It is not that the principles of mechanics are unsound but that the design is based on too many assumptions that are unwarranted.

Engineers cannot hope to maintain pavement slabs 20 ft. or more in length without reasonable expectation that transverse cracking will occur. Unless cracks can be prevented, except as they are provided for, the so-called balanced design is an economic failure. It is doubtful if road slabs more than 10 or 15 ft. in length can be maintained without reasonable expectation that cracks will occur. While such cracks weaken the pavement and, in the case of the balanced design, greatly reduce its safe load carrying capacity, they are not so serious if the concrete slab is designed for a uniform thickness.

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Water Corrodes Copper Pipe

Water attack on copper piping is an unusual occurrence reported by the city of Sioux Falls, S. D., to the engineering division of the State Board of Health. That copper from copper service pipes is being dissolved by the city water is indicated by a greenish deposit in tea-kettles and other cooking utensils, according to a statement by the Board in its bulletin *The Clarifier*. The amount of copper present is not sufficient to be alarming, but the Board is interested in inquiring whether other cities have had similar experience.

Contractor's Liability Insurance

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Contents in Brief *— Through lack of understanding or neglect, contractors are prone to underestimate their liability insurance requirements to meet modern contracting conditions. An insurance underwriter has summarized seven forms of liability insurance that every contractor needs for his own protection and the protection of his client. The type of protection afforded by each form is given, and several instances are cited to indicate the troubles arising from inadequate liability insurance coverage.*

ALL TOO OFTEN contractors regard insurance in the same light as standard materials required for the job—something that is obtained from stock through routine purchases. However, buying insurance is far different from buying materials. Contractors are familiar with materials; they know from the plans and specifications the kind, quality and amount of materials required for each job. A mistake in ordering can usually be rectified without much loss to the buyer; surplus quantities can often be returned for credit. Materials represent tangible requirements.

Buying insurance is something different. In the first place contractors are not as familiar with insurance problems as they might be; and secondly, insurance requirements are intangible. There are no specifications or blueprints that tell the contractor the kind and amount of insurance he needs; or just when he will need it. Yet, intangible as insurance requirements may be, they must be estimated in advance. When the need for insurance arises it is too late to buy the required protection. If the job is short a few loads of sand a telephone call will remedy the situation, but if it is short an insurance policy when needed, it is "just too bad."

Liability insurance

Contractors, for the most part, are well-informed about fire and workmen's compensation insurance, so these forms will not be discussed here. It is liability coverage that is understood least and thus requires more consideration. The seven principal kinds of liability insurance are:

Contractor's public liability
Contractor's protective liability
Contractual liability
Owner's protective liability
Automobile liability
Hired car liability
Non-ownership automobile liability.

Each of these forms will be discussed briefly.

In considering public liability insurance, it is essential to determine just *who* is this public. A contractor can regard every person not directly in his employ as a member of the public. This includes the client, employees of the client, inspectors, delivery men, and the employees of other contractors or subcontractors on the job, as well as all others who might be on the premises or passing by, but who have no connection with the work. Special consideration should be given to children because of the law doctrine known as "attractive nuisance." This includes almost everything that attracts youngsters and might result in an injury.

Contractor's public liability and protective liability insurance need little explanation. Contractor's public liability covers the contractor when he acts as an independent; protective liability protects the contractor who has engaged a subcontractor. If a contractor has the work on a cost-plus basis, he may add the name of the customer to both his direct and protective policies without extra cost. As all standard policies exclude injuries to employees, such policies issued to either contractor or owner should be endorsed to the effect that the employees of either party shall be considered the public so far as the other party is concerned. In the event the contractor should let a subcontract on a cost-plus basis, the same procedure can be followed. Under such circumstances the subcontractor should then eliminate that job from his own coverage to prevent duplication of coverage and expense.

"Save-harmless" causes trouble

Contractual liability is one of the most necessary, but still the most overlooked and least understood of all coverages. It arises from the so-called "save-harmless" clauses that are now being inserted in most contracts. Such clauses should not be included in contracts, for they shift responsibilities of the owner to the contractor. It would be far better to have the specifications carry a stipulation about the insurance to be carried by the contractor. However, as long as these "save-harmless" clauses exist, the contractor must watch out for them. All standard policies insure against claims arising "by operation of the law," but when a claim arises by contract it is not covered unless such contract is specifically insured or provided for.

An example is a recent Cleveland case. A contractor was doing a job for the city upon which a party was injured. The injured party sued the city and secured a judgment, the city then sued the contractor under a clause in the contract where he had agreed to save the city harmless from such damage. The additional liability that the contractor had thus assumed was not insured under the contractor's policy, and therefore he

was unable to recover what he was compelled to pay to the city.

The smart contractor knows that he must not only protect himself, his employees and the public, but his client as well. A case in which the contractor overlooked the client happened recently in Cleveland. A reputable contractor was performing work for a big corporation. An employee of the contractor was injured because of negligence of the customer. Of course, the employee collected his compensation, but as he was not satisfied, he sued and secured a sizable judgment against the client. Naturally, the contractor was embarrassed, for here was an important customer and a good prospect for future work. The judgment was large, too large for the contractor to assume, and he was unable to appease the customer. In retaliation, the customer sued the contractor and although in the end the contractor won out, he lost at least one prospective customer and perhaps more. That contractor knows the answer to that one now. At little expense and with very little trouble he sees that his customer is properly insured at the start of a job and, if not, he buys the insurance for the customer and often says nothing about it.

The type of insurance covering the above case is known as owner's protective liability. The customer may carry liability insurance, but unless it is properly amended it does not protect him in the event of extraordinary alterations and repairs, new construction or demolition. It is the contractor's duty either to call this to the attention of the customer or to insure such liability for him.

Automobile liability is another coverage that needs little explanation, and liability for hired trucks or cars can either be secured separately or added to the contractor's automobile policy. However, ordinary automobile liability does not cover situations that frequently arise on construction work where an employee occasionally uses his own car in the business of his employer. If the employee should injure another party while driving his own car on an errand for his employer, the contractor is liable. Even though the employee may carry liability insurance, the responsibility may fall back on the contractor for one of two reasons: first, that either the company or the limits of liability may not be satisfactory, and secondly, that the employee may be using a car other than the one insured. The remedy is non-ownership automobile insurance to be carried by the contractor, so written to cover any car used in his business that he does not own or hire.

Liability limits

Consideration as to the limits of liability and the policy exclusions is just as necessary as that of the types of liability. A contractor may buy his policies at the beginning of the construction season with what he considers adequate limits, and then go on through the year doing all kinds of work without giving his insurance further consideration. The safest thing to do is to buy insurance with adequate limits in the first place, and then increase the limits as necessary, which can be done at small cost. Beyond that, however, the nature of each job should be considered, especially as regards the number of people who might be injured in one accident, assuming that the first or "individual person" limit is adequate.

Exclusions under policy forms are often misunderstood, but in the insurance contracting business, just as in the construction contracting business, there must be a definite beginning and ending. Responsible insurance companies do not try to evade liability that is intended by the contract, but it is impossible to make a contract that would fit all situations without charging a maximum in every case. The ordinary insurance contract, without special amendments, is prepared for the average case, not the unusual one. Therefore, every exclusion clause should be carefully observed.

The real answer to the contractor's insurance problem, however, is for him to be as familiar as possible with his insurance requirements, and he should also do business with *one* responsible agent. The agent is an expert on insurance matters and the contractor can rely upon him for proper advice and proper coverage.

A Low-Cost Concrete Building

Contents in Brief—Built of concrete made with aggregate of uniform size and no fines, the building shows advantages in economy, a minimum shrinkage and maximum insulation. Because they are porous, the walls take plaster and stucco easily.

A CONCRETE BUILDING recently constructed by Arthur Loepp as a plumbing and electric shop in Coulee Center (near Grand Coulee Dam) was built with a mix deliberately proportioned for a high degree of porosity. The mix is expected to give the advantages of (1) minimum shrinkage (2) maximum insulating value, (3) low cost, (4) walls into which nails can be driven almost as readily as in wood, (5) weight only about two-thirds that of ordinary concrete and (6) surfaces that will take plaster or stucco without the use of lath, expanded metal, or other surface preparation. An incentive to the use of concrete was that, because of the fire risk, insurance rates in Coulee Center on wood frames were very high—about 12½ per cent per annum when this building was started.

The Coulee Center structure has two stories and basement; a total wall height of about 30 ft. Plan dimensions are 30x60 ft.; concrete was used only in the outside walls, whose thickness is 8 in. at the base and 6 in. above the first floor level. Reinforcing consists of $\frac{5}{16}$-in. vertical bars on 2-ft. centers placed midway between form walls.

An unusual mix

The desire was to use an aggregate of most nearly uniform size. The available material that came nearest to this was pea gravel with a size range of $\frac{3}{16}$ to ¾ in. No fine material of any kind was used; the basic idea was to obtain maximum air spaces for the aggregate used, which could be of any ordinary size, so long as the size

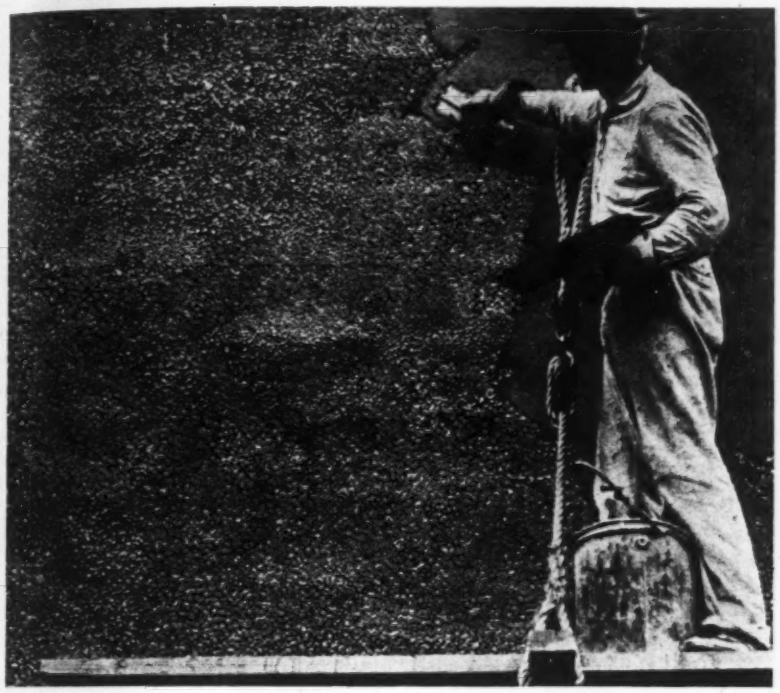

Fig. 1. Applying plaster to the porous concrete wall of a building in Coulee Center.

was uniform. The gravel was put through an ordinary concrete mixer using 3 sacks of cement per cubic yard. The water-cement ratio was such that the resultant mix was dry enough to "stand alone." The criterion for the desirable water-cement ratio was that the water content should be enough to assure thorough coating of the gravel with cement paste but not enough to flow and "blind the pores." A test of this latter condition is that when the forms are removed the outline of each individual piece of gravel can be traced: interstices are *not* completely filled with a matrix in which the individual aggregate particles are embedded and their identity lost.

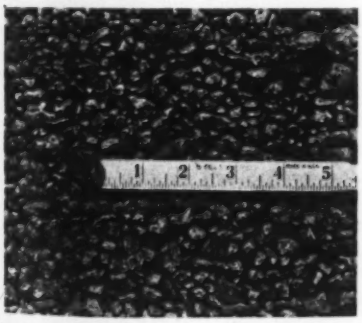

Fig. 2. Closeup of the pea gravel concrete made with three sacks of cement per cu.yd. Each particle of gravel is bonded but not entirely embedded.

With a mix so dry as this, some care was required in getting proper placement in the forms, however, the strength requirement on the forms was very low: ¾-in. lumber was used and 2x4-in. form studs were spaced on 2-ft. centers. Upper floors and flat roof of the building are of standard timber construction framed in the usual manner. The basement floor is porous concrete with 1 to 4 mortar topping. Test cylinders of the porous concrete taken from the forms showed a strength of 1,000 to 1,500 lb. per sq.in. in seven days. After concrete forms had been stripped, an exterior stucco finish was applied with trowels directly to the concrete, and plaster was similarly put on in the interior.

The mix was designed by O. G. Patch, concrete technologist, U. S. Bureau of Reclamation, with a view to developing a type of concrete that will (1) cost less than standard mixes and hence be applicable where ordinary concrete would be too expensive, and at the same time (2) have several advantages over standard mixes. Although the use of porous concrete is not new, Mr. Patch hopes to obtain a patent on its application to the uses just described. He expects to see inexpensive mixes of this type increase the use of concrete in fields where it has not been competitive heretofore.

Low-Cost Concrete Floors

THE ADVANTAGES OF porous concrete described in the preceding article are being tried out in floor construction in two wings recently added to the concrete laboratory at Grand Coulee Dam. The belief is that if the principle is effective in the walls of buildings it will also have advantages in floor construction, particularly in its reduced tendency to develop shrinkage cracks. Moreover, it was desired to experiment with mortar topping mixes having different cement contents.

Accordingly, the new laboratory wings were divided into bays a few feet wide in which different topping mixes were used. The methods of preparing and handling the materials were the same in all cases. The ground surface was first smoothed off and compacted with the aid of such water as it would take. On this foundation was spread the concrete base mix consisting of pea gravel ($\frac{3}{16}$ to $\frac{3}{4}$ in.) into which cement had been well mixed. Cement content was 1 to 10 by weight. The mix was run very dry. After being dumped on the floor the concrete was tamped and screeded to uniform level and the surface was kept damp for five to seven days.

Several days after the 4-in. layer was placed a top coat of sand and cement ½ in. thick was put on. Several top mixes were used, ranging from one part of cement with three parts of sand, to one of cement to six parts of sand. These top coatings were spread on and tamped into the porous concrete base. They were mixed quite dry (0 to ½-in. slump) and screeded off with a rough float. The finished surface was immediately sprinkled with dry cement and fine sand, mixed in equal proportions, given a steel trowel finish, and kept damp for fourteen days. The 1 to 4.5 mix is considered very satisfactory and its cost is estimated at about half that required for standard concrete floor paving and finishing.

Concrete Takes Compression In Timber Truss Joints

JOINTS of unusual design were used in timber trusses supporting walls and roof of the Ford Building and some of the other exhibit palaces at the Golden Gate International Exposition on San Francisco Bay. In a lower chord joint where five timber members come together, a pair of steel gussets was bolted on outside the several timbers to hold them in place and to carry tension. Concrete, vibrated into place between the plates and around the timber ends, as described in the following, formed a common compression block.

The Ford Building is about 195x 254 ft. in plan and, because exterior architectural effects require a series of setback walls, three-hinged timber arches were found to be the most logical structural framework. These arches have a span of 136 ft. 8 in. and a rise of 54 ft. 9 in. between bottom and top pins. They are spaced 40 ft. apart and between them are purlin trusses of 40-ft. span spaced 18 ft. 9 in. apart, carrying wooden rafters and diagonal roof sheathing.

Most of the joints where the 12x12-in. chord and web members meet were made with flush type shear plates and a pair of $\frac{3}{8}$-in. steel gusset plates bolted together. Top and bottom hinges consist of steel pins connected to steel gusset plates and built-in T-sections into which compressive forces come through timber in direct end bearing.

One special joint was used in each half of the truss, namely, the first joint (L_1) of the lower chord, where a heavy compression load is carried and yet where it was necessary to make provision for reversal of stress. Here, when the building walls take a wind load of 15 lb. per sq.ft., the usual compressive stresses will be changed to tension. However, the maximum tension would be only a fraction of the maximum compressions, as indicated in Fig. 1, and hence it was felt that there would be no question about the compressive stresses going directly to a compression block of concrete, poured around the ends of the timbers.

A 4-in. maximum slump was specified for the concrete; this consistency was believed to be right for the two objectives of best efficiency in placement and minimum shrinkage. About $2\frac{1}{2}$ cu.ft. of concrete was used in each joint. Slip in the bolts and shear plates, it was believed, would allow the concrete block to shorten under compressive forces and shrinkage effect, without overstressing those other portions of the joint (gusset plates, bolts and shear plates) that function in resisting tensile stresses.

To facilitate getting the concrete into the joint, a 4-in. hole was left in the steel gusset plate which was uppermost when the truss was assembled on the ground. After the gussets were bolted to the timbers in the usual method, the open spaces around the edges of the gusset plate and between the 12x12-in. timbers were closed with wood blocks, and then concrete was poured through the 4-in. hole into the space enclosed between the two gussets, the timber ends and the blocks. Six $\frac{7}{8}$-in. holes in the top steel plate served as vents for entrapped air and for inspection of vibrated concrete.

This concrete, consisting of a 1:5 mix with pea gravel aggregate up to $\frac{1}{2}$-in. size, thus came into contact with and embedded the ends of the five 12x12-in. timbers. With the use of a vibrator the concrete was thoroughly compacted into place and was made to entirely fill the space. Prior to putting on the gussets, the ends of the timbers were saw-cut for a 12-in. length and painted with creosote to minimize checking effect.

After a minimum curing period of 14 days before moving, these trusses were lifted into position with a crane. Erection stresses and procedure were carefully analyzed and it is believed that no damage to the concrete resulted from handling.

W. P. Day is vice-president and director of works of the exposition and H. C. Vensano is chief of construction. John J. Gould, chief, division of structural engineering, worked out details for the timber joints described.

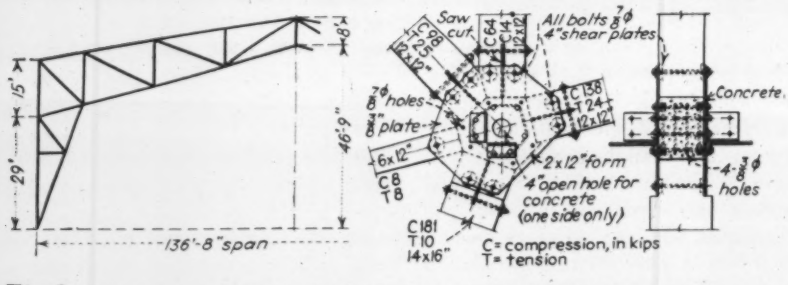

Fig. 1. Sketch shows location of joint L_1 in the truss; details indicate relative position of steel gussets, timber truss members and concrete compression block.

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Oil Field Brine Disposal Is a Costly Problem

The disposal of brine from oil fields in a way not to contaminate fresh groundwaters or surface waters involves many problems of a chemical, hydrological and geological nature, and the cost of proper disposal will be considerable, according to David G. Thompson, senior geologist, U. S. Geological Survey, in a recent paper before the American Geophysical Union. He quoted from a National Resources Committee report in which it is stated that the capital investment that would be required for treating and disposing of oil field brine is conservatively estimated as at least $100,000,000, and it is conceivable that the ultimate cost might be double this figure. Annual operating costs likewise would be high, perhaps as much as 18 to 33 per cent of the capital investment. The problems involved have been under study for some time, and the U. S. Bureau of Mines has recently published data (*Report of Investigation 3434, Typical Oil Field Brine Conditioning Systems*) in regard to seven systems for disposing of brine.

A Five-Year Plan on Sanitary Fills

***Contents in Brief**—Seattle is now in the second year of a 5-year refuse disposal contract using sanitary fills, some in high-class residential areas, at an over-all disposal cost of less than $1 per capita per year. Present practice for reclaiming marsh lands and filling ravines for street construction and park development is based on a half century of experience.*

SEATTLE has pioneered in the disposal of refuse in sanitary fills and in its long experience has developed improved methods and earned the confidence of citizens to such an extent that it was possible recently to enter into a long-term contract for disposal by this method. Under this contract the city health department supervises the fills of which there are six, so located that the average haul, after loading is completed, is not more than two miles. Some of these fills are in high-class residential districts.

Under this contract, which has now been in operation more than a year and is said to be satisfactory in all respects, some 750,000 cu.yd. of garbage and rubbish was disposed of during the first year at a cost of less than $1 per capita per year.

Seattle's disposal of refuse by the fill and cover method began back in the eighties and has never been entirely discontinued. When crude methods on the early fills brought protests, temporary resort was taken in other means of disposal. In the nineties garbage was dumped into Puget Sound from boats, and incinerators disposed of some of it in the 1908–1915 period. As improved methods were developed on the fills, fewer objections were heard. In recent years Seattle's fills have been generally recognized as "sanitary" and are now the accepted and sole means of disposal. Concentrated food waste from hotels and restaurants, however, is not taken to the fill; such waste, held to be city property, is collected separately for hog feeding and yields the city a revenue.

The fills are made on private as well as on city property. The former sites are used where the advantage of short haul is offered, and the latter where valuable land can be made out of ravines, swamps, or other unusable city holdings. In some cases land is purchased by the city as fill sites. The fills are particularly well suited to bringing streets up to grade in undeveloped areas. And Green Lake Playfield, a 35-acre recreational area of great value to the city, was built by a garbage fill on an unsightly swamp. Other articles describing Seattle experience with sanitary fill operations, will be found in *Engineering News Record* issues of Dec. 29, 1921, p. 1080; Nov. 23, 1922, p. 876; and April 26, 1923, p. 761.

Five-year disposal contract

On June 19, 1938, the city entered into a 5-year contract with Diamond Tank Transport, Inc., which agrees to collect householders' garbage and rubbish, haul it to designated disposal areas and there maintain fills to the satisfaction of the Health Department. The contract, to cover all incidental expenses, was for $337,690 per year (the tributary population is now about 350,000) and is to be increased in proportion to the population increases shown by successive issues of the official city directory. The contract was awarded to the lowest of five competitive bidders.

Provisions of the contract include placement on the fills of 50,000 cu.yd. of earth cover material (each year) and as much more as the city may require. However, if more than the 50,000 cu. yd. is required the city is to pay 25c. per cu. yd for the additional amount.

The contractor has been using 63 trucks (61 equipped for handling refuse and 2 for conveying earth): 50 of these are in regular use; others are spares. Average loads are 12 cu. yd. Of 28 loads recently weighed, the average was 2.96 tons per load, viz., 4 cu. yd. per ton.

Collections are made six days per week and while trucks are delivering the contractor keeps one paid man on each fill to direct the dumping and to move the dumping platforms which consist of planks not less than 4 in. thick.

The contractor makes no attempt at salvage but allows pickers to work

Fig. 1. Typical Seattle fill showing the sides covered with earth. Dumping is from plank platforms in which individual planks are moved ahead as the fill progresses.

Fig. 2. Working face on a fill with plank platforms in place. Pickers frequently use a broom handle, to the end of which is attached a stiff wire bent at right angles, for raking over the refuse.

over the refuse and take out such items as they can sell. No strict provisions are made concerning the removal of salvaged materials with the result that piles of rags, metals, etc., frequently are accumulated on the top of the fill near the dumping point. Activities of the pickers are believed to help consolidate the fills.

Fill methods

Typical practice in Seattle consists first, of advancing the fill on a narrow front. In this operation the sides of the fill are covered with earth as the fill advances; the end on which dumping is under way gets little or no earth because continual deposition keeps this area active. The trucks dump over the face of the fill from plank platforms advanced a plank at a time by the fill attendant.

No bulldozers are used and no compaction of the fill is made other than that incidental to trucks moving over it. The cover on top of the fill, consisting of 8 to 10 in. of earth, is not put on daily; sometimes as much as several days or a week elapse between successive applications of earth cover on sides and top. Where the depth of earthfill layer can be chosen freely, 12 to 18 ft. is most frequently used. It is reported that no sloughing occurs even in fills that reach depths of 40 ft. or more.

The six dumps now used are in locations selected with reference to short haul rather than for remoteness from residential districts. Several are in residential areas and one near the state university is within a few hundred yards of very high-class residences. This particular fill probably will have an ultimate capacity of 8,000,000 to 10,000,000 cu. yd. The site is in swamp land where the fill continually sinks into soft mud of great depth (70 ft. or more).

An important feature of fill management in residential districts is the use of a screen made with either a row of quick-growing trees, such as willow or cottonwood, or with lattice fences painted green. Screened from direct view and with the health department supervising sanitary conditions, these fills are being successfully operated in all parts of the city.

Once a week official rat catchers inspect each fill. Cyanogen gas is used wherever rat holes in fill-cover material are found. Once the fill is entirely covered up the decomposition of organic matter produces so much heat that rodent habitation is discouraged. Near faces where fills are actively advancing, the weekly inspection and poison gas keep the rodents well under control.

Temperatures in fills are reported as high and some heat remains for seven years or more; fills ten years old, on being cut, show no higher temperature than that of the surrounding air. Planting and horticultural development on Seattle fills is rated inadvisable for several years after completion because of the temperature. The settlement has been observed to range up to 30 per cent, varying with the kind of material in each fill.

Salvage on the fills

Householders do not sort garbage and rubbish. The contract requires the scavengers to remove whatever is put in cans, with the exception that sod and building materials are taboo. Garden cuttings are taken if they are tied up for convenient handling. The tonnage collected is much greater in winter because of the ashes which, in some locations, range up to 60 per cent by weight. This more than offsets the extra weight of fruit waste in summer.

In several instances streets are being advanced on fills across swamps or arms of Puget Sound. In some of these cases the refuse is dumped directly into shallow water and booms are used to retain floating materials. The booms have been entirely satisfactory for this purpose and little escapement has been noted.

Chas. L. Wartelle is city engineer of Seattle; A. B. Butler is chief sanitary inspector of the department of health.

Fig. 3. Where refuse fills are made directly in shallow water a floating log boom prevents the escape of buoyant materials outside the fill area.

Cofferdam Sealed in a Novel Way

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General Contractors, New Haven, Conn.

Contents in Brief — Divers dig trench and place forms under water to place a ring seal of concrete around the inside of a sheet-pile cofferdam. Sequence of operations and details of formwork are described.

THE OLD but ever-interesting problem of constructing underwater foundations in the dry on rock, with a thin cover of soil, is being interestingly solved by the use of divers and the cofferdam devices illustrated by the accompanying sketch. The work is being done by the writer's firm on the new bridge that will carry Ferry St. over the Quinnipiac River at New Haven, Conn., and includes two bascule piers and two abutments. This article describes the method as it was used on the first pier now under construction and as it is planned for the other foundations.

At the bridge, the rock, a hard redstone, is 32 ft. below mean high water and the channel bottom is 23 ft. deep leaving a 9-ft. earth cover. The drawing shows the cofferdam arrangement used.

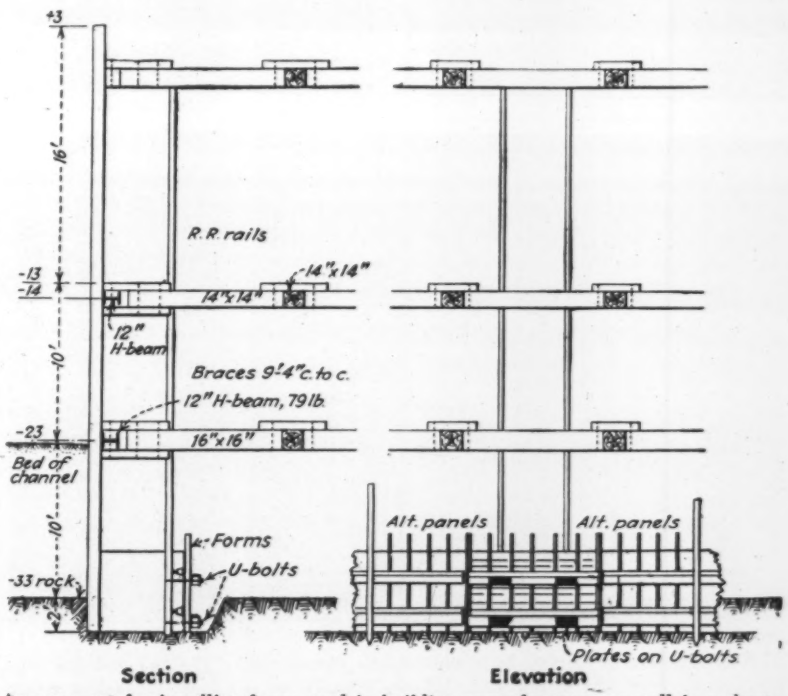
The first operation was to drive the sheetpiles lightly to the rock and assemble the bracing system complete, with the three layers of braces, and sink this cage to the bottom of the channel. Then the earth was excavated to subgrade over the entire area inside the cofferdam, after which the excavation was carried into the rock for a width of 5 ft. around the entire perimeter of the dam and to a depth of about 2 ft. below the surface of the rock, using divers equipped with picks and shovels. The sheeting was then given a second driving to solid rock and the bracing system was lowered to its final position.

The third operation was also a diver's job. Form panels which had been made up on the surface were placed at the inside edge of the 5-ft. excavated area. They were lowered, using as guides railroad rails which had been pointed and driven into the rock as shown. The panels were 9 ft. long (the size of the bays between the braces) and were weighted with short pieces of rail fastened in a horizontal position. They were held to the vertical rails by U-bolts. The plates on these U-bolts later provided bond for the reinforcement in the concrete foundation mat. Alternate panels were 2.5 ft. longer than the others and were placed after the others were all in position, as shown. Two divers worked together on each panel and their movements were directed and coördinated by telephones, one of the divers acting as foreman, relaying his instructions to the other diver through the tenders above.

The fourth step was to place concrete to make a perimeter wall 5 ft. wide and 5 ft. high after the area had been given a final clearing by the divers. The concrete was placed by buckets built by the contractor for this particular work. The available space for a bucket in the area between the rangers and the rails on the forms was only 2.5 ft.; therefore, the two underwater concrete buckets were built 2 ft. square and held 18 cu. ft. Although the volume of concrete deposited in this wall was only 250 cu. yd., the care used in depositing it required 20.5 hr. with two lighters. Each bucket of concrete took about 7 min. from the time it reached the chute and passed down through the water and returned to the chute. The concrete specified for the foundation mat is 2,000-lb. concrete, but the contractor added an extra bag of cement per cubic yard to the concrete used in this seal wall.

The cofferdam was pumped out on the tenth day after the seal wall was poured. There was no leakage at the seal wall; the usual leakage through the sheeting was collected on top of the wall and led to the pumps by a dam of sand bags placed on top.

W. V. Barry is director of public works and city engineer for New Haven. George D. Casey is the resident engineer inspector for PWA, Irving Alpert is the resident engineer and Vincent Maher the inspector for the city of New Haven. The superintendent for the contractors, C. W. Blakeslee & Sons, Inc., is John Bursey.



Arrangement for installing forms used in building an underwater sea wall in a sheet-pile cofferdam.

Electrically-Heated Asphalt Plant

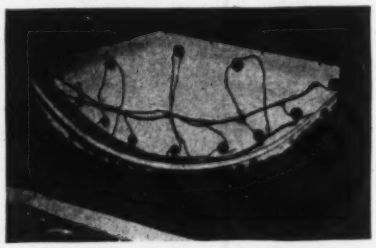
New Jersey contractor replaces steam heating with electric units, resulting in better product at lower cost

ELECTRICAL HEATING of asphalt at the plant of the Franklin Contracting Co. of Newark, N. J., is producing a more uniformly heated bitumen with corresponding better quality paving material at a lower cost than did the steam heating method formerly used. A further saving in cost of operation is obtained by hooking the heating and plant circuits to a demand limiter along with the circuit from the company's electrically-operated quarry, thus resulting in a lower unit rate for power used at both locations.

The contractor operates on this property a quarry, a readymix concrete plant, an asphalt distributing plant and two bituminous highway mixing plants, one for sheet asphalt and the other for cold mix. At the plant, the bituminous materials are stored in three 18,000-gal., one 15,000-gal. and one 8,000-gal. tanks. A 3,000-gal. Clarmac Superheater is also used. Formerly the tanks were heated by steam at 100-lb. pressure, requiring continuous firing of the boilers day and night. At times when withdrawals of heated bitumen and addition of the cold product were heavy, particularly in winter, maintaining constant and uniform temperatures in the tanks was difficult. This condition affected pumping and mixing of the bitumen with the aggregate.

Electric heaters

Last year the contractor switched from steam to electric heating, which has proved very satisfactory, especially during cold weather operations. Into each storage tank was installed a suitable number of immersion-type electric elements and automatic temperature control equipment, operated on a 440-v. circuit. The number of elements was determined by the rate of heating required and the temperature at which the tank would be operated. The heating is done entirely off-peak, during the night when the remainder of the plant is shut down. This permits more economical operation as a better current rate is thereby obtained. In addition to supplying uniformly heated bitumen, resulting in a uniform mix, electric heating has accounted for a saving of approximately $25 per day in plant operation.



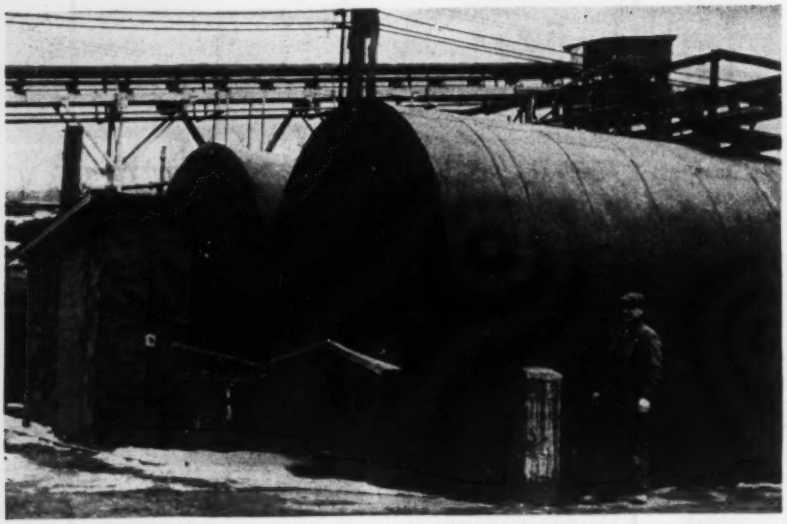


Fig. 1. Electric heaters in insulated asphalt storage tanks (below) provide uniformly-heated product at low cost. Heater connections are made through a sector at end of tank, as shown here. Control panels are in house at left. Detail at top shows the insulated heater connection sector with cover removed.

Fig. 2. Demand Limiter Installation. *A*—Demand meter which records kilowatt demand at 15-min. intervals; *B*—Light source of demand limiter; *C*—Photo-electric cell; *D*—Arm supporting light source and photo-electric cell, swung clear when chart is read; *E*—Watt-hr. meter for measuring power used on off-peak periods, 8 pm. to 8 am.; *F*—Time switch for automatically connecting and disconnecting watt-hr. meter; *G*—Master control cabinet which operates relays for disconnecting load to keep demand peak to predetermined level.

Demand limiter

Further saving of some $50 per month in power costs is effected by the use of a power demand limiter, which limits the demand to 300 kw for both quarry and asphalt plant. This device works in conjunction with a demand meter (Fig. 2). When the needle of the demand meter swings up to the predetermined value of 300 kw a photo-electric cell operates a relay that cuts off the current

on the heating units and on certain motorized equipment at the quarry, which does not seriously affect quarry operation. As the needle on the demand meter returns to zero to begin the next peak demand measurement, the demand limiter automatically cuts in the current that was shut off a short time previously.

J. L. Hill is president and C. H. Hallenbeck is vice president of the Franklin Contracting Co. I. Peter Zito is superintendent of the asphalt plant and D. C. Britt is superintendent of the quarry. The electric heating system was designed and installed by the Easton Car & Const. Co., Easton, Pa.

Sewage Disposal for Delhi, India

A NEW sewage disposal treatment plant of the activated sludge type, with sale of effluent for irrigation and sludge for fertilizer, now serves the ancient and modern cities of Delhi and also the adjacent city of New Delhi, built within very recent years as the capital city or seat of the Government of India. As described in *The Engineer*, of London, by J. A. R. Bromage, formerly superintending engineer of the city's health services, it is designed for a population of 750,000 by 1955, with a dry-weather sewage flow of 24 mgd, but having a capacity for dealing with three times that amount during the rainy season. Any further increase in stormwater would then pass directly to the Jumna River, which is in flood at such season and gives ample dilution. Temperatures range from a few degrees below freezing to 140 deg. F.

Due to gross misuse of the sewers by an illiterate population there is an excess amount of floating matter in the sewage of Indian cities. The screening chamber into which the two outfall sewers discharge is 40 ft. in diameter and has two vertical screens 12 x 8 ft., with bars ¾ in. apart, while space between them is provided for a third screen. Cleaning is effected by automatic grab rakes which have no moving parts permanently submerged. Screenings are discharged onto a belt conveyor and delivered to dump wagons for burying or incineration. Beyond the screens, curved weirs divert the lower part of the flow, which contains the road grit, into two hopper-bottom wells, while the upper part flows on to a suction channel for the pumps. In these detritus wells, the sewage flows down and then upward, dropping its heavier suspended matter, and then flows over radial weirs to the suction channel. A gravel pump removes the grit and delivers it to a separator.

Three triple-expansion duplex pumps of 12-mgd capacity each against 60-ft. head (but one of which is always held in reserve), are supplemented by three electrically-operated centrifugal pumps of the same capacity, while provision is made for three additional units. Two force mains 800 ft. long discharge into a well at the head of a 4-mile gravity flume of U-section, 6 ft. 3 in. wide and 7 ft. deep, the circular invert insuring a fair velocity at low flow.

The treatment plant, at the end of this flume, can now deal with a dry-weather flow of 18 mgd, but can be extended to handle 24 mgd. Treatment includes preliminary sedimentation, with 1½ hours' detention; aeration for 12 hours, and final sedimentation for 6 hours. Entering sewage passes through a flow recorder to a channel across the full width of the plant and surplus activated sludge is discharged into this channel. Through 24-in. bottom valves the sewage flows to 12 primary settling tanks 30 ft. square and 37 ft. deep, having hopper bottoms. Deflector boxes prevent the flow from agitating the liquid in the tanks. Sludge is drawn off at intervals through 6-in. pipes to a channel and taken to the drying beds.

Clarified sewage passes on to another transverse channel into which activated sludge is fed and from which the flow is to a group of 108 aerator tanks 30 ft. square. In the center of each tank is a concrete riser pipe having at its top a conical wheel which draws the sewage up and diffuses it in finely divided state over the surface of the tank liquor. Baffles cause a sinuous flow through the several tanks. The wheels are carried by vertical geared shafts depending from concrete bridges, each bridge spanning nine tanks. Adjustable weirs at the outlet regulate the level of the liquid and the submersion of the cone wheels. At present the depth of submersion is uniform, but experiments have been made with deeper submersion for the first two or three wheels in each line, in order to give greater aeration where it is most needed.

Flow over the weirs goes to a transverse channel feeding the 48 final settling tanks, which are similar to the primary tanks. In a 9-day test, the character of the effluent in parts per 100,000 were as follows: suspended solids, 0.60 to 1.30, average 0.95. Albuminoid ammonia, 0.12 to 0.14, average 0.13. Five-day B.O.D., 0.74 to 1.20, average 1.0. The minimum requirements of the British Royal Commission on Standards are 3.0, 0.2 and 2.0, respectively.

Sludge from the primary tanks is conveyed 0.66-mile to six drying beds 700 x 500 ft., having 3½ ft. of stone of graded sizes on a concrete floor. The drainage is returned to the incoming sewage by automatic pumps. There is a growing demand for the sludge as fertilizer and the surplus is carried by dump wagons to fill a depression. Activated sludge from the final tanks is removed by automatic desludging apparatus and pumped either to the incoming sewage or to the inlets of the aeration tanks. Final effluent flows to the river through a 2-mile channel. Since this flow at low stages of the river would be a hazard to public health, a chlorinating plant is provided at the channel entrance.

The original design, as prepared by Mr. Bromage, provided for sludge digestion and the possible use of sludge gas for power. He states his opinion that: "During the hot weather, despite all precautions, fly breeding will start on the sludge drying beds and, sooner or later, digestion (deferred to reduce cost) will be adopted. . ."

About 3,000 acres are commanded by gravity flow from the effluent channel and irrigation is being developed rapidly, while additional 1,000 acres are irrigable by pumping. Sales of sludge are developing more slowly, but it is anticipated that when the results of one crop are seen the demand will rise rapidly. The entire plant is administered by the Delhi Joint Water and Sewage Board.

Civil Engineers Meet at San Francisco

Sixty-ninth annual convention of Am.Soc.C.E., with registration exceeding 1,600, covered wide spread of topics and recorded much useful data

WITH A RECORD registration of more than 1,600 members and guests of the American Society of Civil Engineers, a typically western gathering at San Francisco last week discussed current technical topics and carried out a busy program, supplemented by inspection of the two notable bridges on San Francisco Bay and the Exposition that commemorates the bridge construction. A feature of the program was the emphasis on earthquake-resistant design in structures generally and for both of the bridges. The outstanding character of the series of papers in the structural division justifies separate and more extended treatment, which will appear in an early issue.

Other divisions that held sessions were hydraulics, irrigation, waterways, soil mechanics and foundations, power, sanitary engineering, city planning and highways. Continuing with the program begun at Chattanooga in April, the symposium on masonry dams was completed at this meeting.

In the joint session with which the convention opened, President Donald H. Sawyer spoke on "Frontiers of Engineering," picturing the alternate courses of progress and stagnation in professional activity. He made a plea for a combination of effort in creative improvement, pointed out the problems and opportunities in the construction field and, in outlining a program for future progress, emphasized the need for greater sums to be set aside for research.

Irrigation canal problems

The irrigation and hydraulics divisions of the society held a joint session in which one of the important papers on silt problems of the Imperial Irrigation District, resulting from the completion of Boulder Dam, was given by M. J. Dowd, the district's chief engineer. The silt now received is smaller in quantity, of coarser texture, settles more readily and is more difficult to remove. Some canals, which formerly built up above the adjacent land surface (as continued silt removal to the banks raised the adjoining levels) are showing bed erosion and lowering of the water surface. This is helpful as it tends to balance the increased seepage that results from the present clearer water. The clearer water has increased the aquatic and bank vegetation.

Robert T. Knapp, California Institute of Technology, described experiments in the design of curves for high-velocity open channels. An analysis of the cause of waves on the curves showed that oscillations having a different velocity from that of the flowing water can be induced by diagonal ribs on the bottom of the flume or by transition sections having different radii from the main curves, with the result that smooth flow can be secured. These corrective measures are needed at both entry and exit of the curve section, and can be made effective in both rectangular and trapezoidal flumes.

In a paper entitled, "Canal Linings," Clyde W. Wood, president, Metropolitan Construction Co., Los Angeles, pointed out how the early practice of making side slopes 1 to 1 has proved uneconomical and how practice today ranges between 1¼ and 1½ to 1. As land prices have increased, however, ditches have given way to underground pipelines, and this trend, once started, may be expected to continue.

Touching on recent development of equipment to meet higher costs for labor, and the trend to larger canal sizes, Mr. Wood described the subgraders he designed for the Metropolitan Water District and the "moving form" that placed concrete linings in these large canals at rates as high as 1,000 cu.yd. per 8 hr. Placement of this concrete, without construction joints, throughout the day's pour, was so accurate that the overbreak averaged less than ⅛ in. for 62 mi. of canal lined, totaling 20,000,000 sq.ft. The tendency of designing engineers to disregard the advantages of size standardization in canal sections makes it necessary that all such equipment be "tailor made" for each job. Worthwhile savings could be made by standardization, in Mr. Wood's opinion.

In opening the session of the irrigation division, A. Griffin, chairman, pointed out that it is the smallest division, present membership being 494 as against 1,053 when it was first organized 17 years ago; the loss is attributed to newly formed divisions on hydraulics, soil mechanics and power.

A. N. Khosla, executive engineer, Punjab Irrigation District, Punjab, India, reported that studies of water percolating through a pervious foundation under a dam showed that atmospheric temperature changes accounted for previously unexplained pressure variations of wide range.

Preventing flood damage

Reconstruction of railway properties in southern California, damaged by the storm and floods of March, 1938, was described by W. H. Kirkbride, chief engineer, Southern Pacific, who laid down five fundamentals in planning to prevent recurrence of this severe storm damage. His suggestions were: (1) construct impounding dams for water and debris on the upper reaches of the streams; (2) construct settling basins lower down, near the mouths of the canyons; (3) eliminate tortuous alignment of stream channels; (4) construct concrete-lined channels on proper hydraulic grades across lowlands to the sea; and (5) recognize

the fact that debris basins will fill up, and that a yearly program of debris removal must be carried out.

Masonry dam symposium

The symposium on masonry dams, sponsored by six of the technical divisions and carried out under the auspices of the power division, began where the April meeting at Chattanooga left off.

Aimed at a pooling of information, data presented dealt with the geology of dam sites, concrete control, construction joints, structural and hydraulic model testing, stress determinations and trends in design and construction.

The last named topic was covered in a paper by A. V. Karpov, consulting engineer, Pittsburg, who sounded the keynote for the symposium with a summation of the best practice in selecting and preparing a dam site and constructing a dam thereon. Obtaining for the dam the maximum possible assistance from nature is the real engineering problem, he said. More study should be given to the canyon cross-section, there should be a better balance between engineering and experience, and toe and heel of dam sections should be streamlined with fillets to reduce stress concentrations.

B. E. Torpen, principal engineer, Corps of Engineers, Bonneville, Ore., thought that new types of dams would come into vogue, bringing greater economy. J. C. Stevens, consulting engineer, Portland, drew attention to the interest of the late D. C. Henny in a type of dam that would be made of precast concrete blocks, and suggested that the idea should now be studied further.

Earthquake studies

Since 1925, when the U. S. Coast & Geodetic Survey became a clearing house for earthquake investigations, it has been carrying on an instrument program to obtain for structural engineers data useful in earthquake resistant design. This work was summarized by Capt. R. R. Lukens of the Survey, who said that fifty strong-motion seismographs, now located in California and adjoining states, automatically start to record when a fairly strong earthquake occurs. These instruments operate for 1 min. and then stop, but are started again by subsequent heavy shocks.

Looking toward earthquake prediction, the Survey now has in operation three tiltmeters that register infinitesimal changes in inclination of the earth's surface. Also, sensitive microphones have been suspended in deep wells to pick up any sounds that may be given off by subterranean strata under strain. These studies lay the groundwork for future development.

Fort Peck slide and repair

The session on soil mechanics and foundations devoted most of its time to papers and discussions relative to the slide in Fort Peck Dam. Major Clark Kittrell, Fort Peck district engineer, Corps of Engineers, described foundation conditions, construction methods, and just what occurred at the time of the 5¼ million-cu.yd. slip. Outlining the findings of the advisory board of engineers, he said reconstruction was now going on in accordance with the majority report of the board, calling for a rolled-fill core with additional material on the upstream face.

"Tests and Analyses, after the Fort Peck Dam Slide," was the subject of a paper by T. A. Middlebrooks, senior engineer, office of the Chief of Engineers, Washington, D. C., who outlined the exhaustive studies of core and shell after the slip. One of the major causes, he thought, was trapped water, squeezed down from seams by concentrated load of fill. Bentonite and shale were the weakest elements of the foundations, he pointed out, and bentonite was found mixed with all gouged material after the slip. Coefficient of friction of the core material was found to average 0.6.

Supporting the conclusion that the hydraulic fill was not at fault, he cited the relatively high core consolidation and vertical slopes in the core face after the break.

In discussion, Thaddeus Merriman, New York, said that the two papers had not touched on the real causes of the slip. He disapproved applying to structures formulas based on the results of small-scale tests, to the exclusion of judgment based on experience. The weathered shale, including the bentonite seams which are the weak materials on which the dam is being built, should have been removed to afford a desirable margin of foundation stability. He also pointed out that the usual practice is to strip undesirable materials from the abutments of all dams. In the present case this was not done, he said.

Discussion by Glennon Gilboy, Massachusetts Institute of Technology, covered three general topics: (1) foundation shears, (2) core liquefaction, and (3) criteria of design; any of these factors could, and probably all did, contribute to some extent to the slip. He stressed the fact that where saturated sands undergo changing pressure conditions the fill stability may change widely and suddenly. Slides at Fort Peck and in other dams, he said, should not brand this type of construction as inherently dangerous—we simply have much to learn.

Joel D. Justin, Philadelphia, though that the removal of weathered shale, as urged by Mr. Merriman, was impracticable because the yardage to be excavated would have been prohibitive; also the incidental cofferdam would have been impracticable. The slip constituted a full-scale laboratory test, he pointed out, in which a 1:8 slope stood, and a 1:4 slope did not, thus indicating the logical basis for reconstruction plans.

Earthquakes and foundations

The effect of foundation on earthquake motion was discussed by R. R. Martel, California Institute of Technology, who emphasized our lack of understanding of the basic relations of foundations and structures. Illustrating how widely conditions differ, he cited two schools in Long Beach that experienced two earthquakes a few months apart. The first, and much the heavier, shock so seriously damaged the older school that it was vacated. The new school was only slghtly damaged and all pupils were transferred to it. In the second quake, the old building suffered so much less than the new building that the pupils were transferred back to the old structure while repairs were made on the newer one.

Discussion by C. J. Derrick, Los Angeles, pointed out that there has been little real progress since the early Twenties in studies of ground periods. He stressed the importance of establishing facts about natural or free ground periods and their relations to movement in buildings. Casual and academic study of this topic, he said, would not produce the needed results: the urgent need is for leadership and for some definitely

established agency to direct the expenditure of the considerable sum of money that would be needed.

Chicago River lock

Lake Michigan, from which Chicago gets its water supply, and the Chicago River, into which sewage plant effluent is discharged, are now physically separated by a man-made barrier. This barrier, in the form of a lock at the mouth of the river, and the events leading up to its construction, formed the subject of two papers. The first, by Capt. S. N. Karrick, district engineer, U. S. Army, detailed the historical phases of the problem, while the second, by H. P. Ramey, assistant chief engineer, Sanitary District of Chicago, described the design, construction and preliminary operation. Limited funds forced a radical departure from the orthodox method of lock and wall construction, so that, as built, the lock consists of a series of rock-filled circular cells of interlocking steel sheetpiling. Two massive concrete gate foundation structures, one at each end of the lock, and two control gate sections, were built in the dry inside cofferdams.

The gates, which were designed to withstand a head of 8 ft. in either direction, are novel, being triangular-shaped and, when partly open, give three passages for the admission of water to the lock. There are no filling gates or conduits; equalization of head occurs by opening the gates. Sluice gates in adjacent walls control the flow of water from lake to river, but reverse action is prevented by the use of flap gates.

Central Valley benefits

Following a description of the Central Valley project, including a showing of colored slides on the construction of Shasta Dam by Walker R. Young, supervising engineer, U. S. Bureau of Reclamation, Major F. M. S. Johnson, division engineer, U. S. Army, San Francisco, discussed the effects of the project on navigation and floods. By evaluating savings he indicated that some $5,000,000 could be credited to the project for the benefit of navigation and $12,000,000 for flood protection. Evaluation of agricultural benefits, so Mr. Young stated, is under study. The navigation benefit is based on release from Shasta of 3,000 cfs to produce a 6-ft. depth from Sacramento to Chico Landing. C. S. Jarvis, hydraulic engineer, U. S. Department of Agriculture, asked about a salt water barrier on which he had reported years ago. Mr. Young said that Mr. Jarvis' plan was one of three studied on which costs varied from $46,000,000 to $90,000,000. Such a barrier, he said, would conserve 3,300 cfs, and when this water is needed for irrigation a barrier at some point doubtless would be built.

Sanitary engineering

One of the important subjects covered in the sanitary engineering division session was watershed sanitation and control. Eastern methods, especially in New York State, were outlined by C. A. Holmquist and C. R. Cox, New York State department of health. Strict regulations have been superseded by education and cooperation, which have been shown to produce better results. The same plan is followed for some of West Coast watersheds, but there are still stiff penalties for trespassers where vast watershed areas are owned outright.

G. E. Arnold, chief water purification engineer, San Francisco, stated that water officials often place too much emphasis on the effect of garbage and trash on watersheds. Now that we know how to treat water, he said, why not sell some of the enormous acreage of lands held and buy filters. In any event, it is impossible for guards to keep people from using watersheds for recreation.

In another paper the first year's operation and tuning-up experience on the Minneapolis-St. Paul sewage treatment plant was given by George J. Schroepfer, chief engineer and superintendent. Cost of operation has been $8 per million gallons, nearly one-half of which was for sludge handling. No chemical treatment was practiced, as river flows were high. Suspended solids removed averaged 81 per cent, and the 5-day B.O.D was 53.5 per cent.

In discussion, F. C. Roberts, Jr., Arizona state sanitary engineer, described development in Arizona of the Scott-Darcy chemical process of sewage treatment. Chemicals are used for four purposes: to aid coagulation and flocculation; to remove sulphur compounds that cause odors and deterioration of sewers; to maintain sewage in long sewers fresh until it can reach the treatment plant; and to kill bacteria. Chemical plants are located in Tucson, Chandler, Glendale, Phoenix and Wickenburg.

The sanitary fill method of garbage disposal, as practiced in San Francisco and in Fresno, was outlined in detail. John J. Casey, city engineer of the former city, related the favorable results of dumping and covering that city's 600 tons of garbage for 5 years on a tidal flat in an industrial area without nuisance from rats, flies or odor and to the satisfaction of the city board of health.

The Fresno method, using farm land of medium value, has also enjoyed success for several years, according to J. L. Vincenz, commissioner of public works. About 30 in. of loose dirt is used to cover the dumped material which is advanced toward a 2½ to 3-ft. trench from which a dragline lifts the covering material. Prompt and adequate covering appears to be the success factor in both these cities.

Highway problems

Two-thirds of the cities of California and 17 counties have zoning ordinances although no county zones its whole area, said L. Deming Tilton, California State Planning Board, in a paper on roadside control through zoning. A new law authorizes freeways as one solution of control of roadside developments, he pointed out. Another solution would be for local planning agencies to make master plans to be checked by some state agency. Still another would be for the state to take scenic easements along its highways.

The above paper and one by L. I. Hewes, deputy chief engneer, U. S. Bureau of Public Roads, on "Metropolitan Highway Problems," were presented at a combined meeting of the city planning and highway divisions. Unless mass transportation can be increased, Mr. Hewes holds, motor vehicle traffic will stifle itself in many places.

From the recent full report made to Congress by the Bureau he noted the following: Capacities on metropolitan routes can be increased by elimination of interferences. Traffic has increased on highway approaches to large cities and is smaller than anticipated on bypasses around the cities. Heavy cost of rights-of-way have not been met from current revenues. Land and property costs on nine Pacific coast projects were 55 per cent of the total cost. These facts give some clue to the solution of metropolitan highway problems, he pointed out.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Measuring Cable Pull

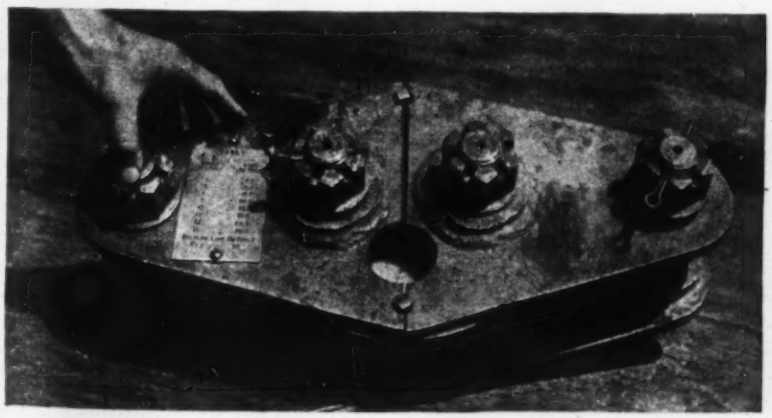
A device for quickly measuring the tension in each cable of the anchor system used on caissons for the Tacoma Narrows Bridge piers was developed on that job. In principle the device carries the strain from the cable through a circular steel collar, measures the decrease in diameter of the collar at right angles to the direction of strain and, by means of a conversion table, translates the reading into tension in tons.

There are two bolts outside the collar and two on the inside, as shown in the picture. Each pair of steel plates transfers load from outer to inner bolts, and between the inner bolts the load passes through the steel collar. Transverse diameter changes resulting from load are read on the Ames dial, visible through the circular opening in the plates. The small tap bolts between the plates do not transfer any stress; their function is to prevent the collar from slipping around the bolts, which might occur when the device is not under strain.

On this job it was advisable to use materials readily at hand, and hence a conversion table was necessary; this is seen fastened to the face of the instrument on a brass plate at the left. If a collar of the exact thickness desired could be had it would be possible to have the dial reading in thousandths equal the tension in tons.

This particular instrument was made up for use with $\frac{3}{4}$-in. cable and proved to be so convenient that the time required for adjusting tension in the several anchor cables was greatly reduced. In operation the device was put at some convenient point in a cable from the winch to a connection, by means of a wedge-type clamp, with the cable whose tension was to be measured. The dial could be read as soon as the winch had tightened up on the line enough to take the load.

The device was developed by Theodore M. Kuss, chief engineer of the Pacific-General-Columbia Construction Co., by whom the general contract on the bridge is held.



The Ames dial measures the decrease in transverse diameter of a steel collar; this change is calibrated in terms of the tension to be measured

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Magnet Frees Concrete Of Scrap Iron

A magnet removes 10 lb. of iron per day from mixed concrete passing by belt conveyor from mixer to a screw conveyor discharging into lining forms of the 2-mi. Des Plaines Ave. water tunnel in Chicago. The iron removed is in the form of small nails from dynamite boxes and track nuts and bolts. The bolts cause the most trouble by jamming under the screw blade.

As a special test of the magnet twelve large marked bolts were buried in the stream of concrete on the belt. All twelve were retrieved and found clinging to the magnet, having been pulled up through $2\frac{1}{2}$ to 3 in. of concrete. The rectangular shape was specially designed for pulling iron from materials on a belt. The magnet was made by the Dings Magnetic Separator Co., Chicago.

Magnet suspended over stream of concrete on conveyor belt retrieves 10 lb. of tramp iron per day.

* * *

Brief Memoranda

The closed traverse enables the surveyor to know with absolute certainty whether his angles are correctly measured, after the last one is read. But if an error be discovered he has no means of knowing where it is—without employing the needle as he goes along—and local attraction may render the needle practically useless. A solution of the difficulty is to measure both the interior and exterior angle at every vertex. If the sum is 360 deg. the surveyor is absolutely sure he is right. In preliminary surveys—railroad or highway—where it is customary to measure only the deflection angle, an absolute check may be obtained by measuring the supplement of the deflection angle, provided, of course, the transit is in perfect adjustment.—Gordon Dinsmoor, Topeka, Kan.

A white paint for swimming pools, which has been used extensively by Ray E. Behrens, senior assistant engineer, Milwaukee County Regional Planning Department, Wisconsin, is employed as follows: All interior concrete surfaces are scraped clean of foreign matter and washed down with a hose. The surface is to be damp or wet at the time of application. Make a mixture consisting of 100 lb. of hydrated lime, 50 lb. Atlas White cement, and 10 lb. of common table salt, stirred in with water until it has a gravy-like or paint consist-

ency and the salt is fully dissolved. Apply this to the wet surface, using a heavy whitewash brush. Two applications can be given one day apart. Allow 24 hr. to dry after the final coat, then turn the water back into the pool.

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Pavement Resurfacing

W. R. MACATEE
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In resurfacing operations using asphalt mixtures for the purpose of salvaging portland-cement concrete and other somewhat impervious surfaces, a paint coat on the old surface is highly desirable. Care should be exercised to keep the primer or paint coat to a minimum quantity, thus preventing excess of bitumen coming through the new surface. About 0.1 gal. of suitable asphalt primer per square yard of surface is usually ample. The distributor spray bars should be kept clean to insure uniform application.

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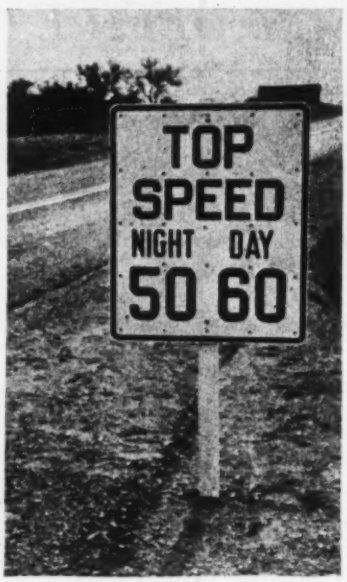
Ashes and Cans Make a Roadway

Heavy truckloads of garbage en route to a dumping point on a large sanitary fill at Portland, Ore., have to pass over a considerable area of the fill on which the surface is rather unstable, particularly in wet weather. Residue from the ash pits of a nearby garbage incinerator, disposed of on the same dump, runs heavily to tin cans—sometimes has a 25 per cent can content. This residue has been used with great success as roadbuilding material by simply spreading it along the route and going over it several times with a tractor.

Building up the road base in this way, as the fill depth increases, maintains a roadway that is very satisfactory for heavy trucking; it settles less than the adjoining fill and gives firm footing in all weathers. This is such a desirable solution of the roadbuilding problem on this fill that the superintendent says: "Sometimes we run the incinerator to get road-fill material."

A roadway on Portland's sanitary fill built mostly of tin cans and ashes.



CAMERA MEMORANDA

Setting the speed limit from actual driving tests, and signing the curves with actual safe speeds, the Arizona highway commission has reduced accidents on 110 mi. of U. S. Route 60 more than 30 per cent.

Traffic engineers and highway patrolmen drove the route and noted the safe speeds for both day and night conditions. Sight distances on horizontal and vertical curves were taken.

The survey disclosed that the safe driving speed at night was less than during the day, which led to establishing a lower legal speed limit for night driving than for day driving. Curves and hazardous places, instead of being signed with the usual slow sign, were given driving tests and a sign erected giving the safe speed in miles per hour.

To prevent cars passing within the minimum sight distance zones, the centerline stripe is given a distinctive pattern; the centerline being a series of dashed lines, with an additional solid stripe placed next to the centerline on the side of the road for which the sight distance is restricted. E. V. Miller is state safety engineer.

A Simple Float For Pump Control

HAROLD K. PALMER
Los Angeles, Calif.

A piece of 2-in. plank makes a very good substitute for the ordinary copper-ball float for operating a float valve, and it has the advantage that the water level can be pulled down farther because it draws less water. The wood can be coated with tar or be made waterproof with suitable paint but if it is not so treated and becomes water soaked it will still function satisfactorily if the counterweight is heavy enough.

The power required to actuate the switch is provided by water displaced above or below the normal draft of the float, and the greater the area the less the required depth, and consequently the greater the sensitivity. Roughly 1.75 cu. in. of water weighs

1 oz., so that if the switch requires a pull of 10 oz. 17.5 cu.in. of water must be displaced to actuate it. Therefore a float 10 in. square would sink 0.175 in. deep, whereas a 6-in. round copper float would sink 0.625 in. The float should weigh as much as it can without sinking if the chain breaks, and then be provided with a counterweight which weighs half as much, and which pulls it half out of water. This provides equal weights for opening and closing the switch if it is operated by a chain. For rod operation the float should normally float only half submerged.

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Computing Pile Groups

CHARLES E. SHARP, JR.
University City, Mo.

The common method of computing the section modulus of symmetrical pile or rivet groups by squaring a series of numbers and dividing by the greatest is somewhat cumbersome. In the usual case of regular spacing of units it may be superseded by the following simple formula developed by the writer:

$$\text{Section Modulus} = \frac{sN(N+1)}{6}$$

for each line of units, where s equals spacing of units and N equals number of units in each line.

Thus, for a footing containing 5 rows of piles, 10 per row, and spaced 3 ft. on centers each way, the section modulus in the long direction is $3 \times 10 \times 11 \div 6 = 55$ per row, or 275 for the 5 rows. The section modulus in the short direction is $3 \times 5 \times 6 \div 6 = 15$ per row, or 150 for the 10 rows. The above formula may be derived as follows:

For the section modulus of a group containing a number of units N, let n = number of spaces on either side of the center line. Now, the sum of the squares when N is odd is $\Sigma(1^2 + 2^2 + 3^2 + \ldots n^2)$ and when N is even $\Sigma(.5^2 + 1.5^2 + 2.5^2 + \ldots n)$ which, by the formula given in algebraic textbooks is equivalent to $n\ (n+1)\ (2n+1) \div 6$. Hence the section modulus for the whole line is $(N+1)\ (2n+1) \div 3$. But $2n + 1 = N$ and $n + 1 = (N+1) \div 2$. Hence, section modulus $= \frac{N(N+1)}{6}$ for unit spacing or $\frac{sN(N+1)}{6}$ for spacing s.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

AERATED FILTERS — It is claimed that an enclosed aerated filter will treat three times as much sewage per cubic yard as an ordinary open filter and yet produce an effluent of equal quality. Plant scale experiments made with filters 6 and 13 ft. in depth by Hurley and Windridge (*The Surveyor*, May 27, 1938), supplying 600 cu.ft. of air per min. to the shallow and 200 cu.ft. to the deep filter, showed that 167 gal. of sewage per cu.yd. per day could be applied to the deep enclosed aerated filter and only 50 gallons to an open filter in order to obtain a 95 per cent reduction of the five day B.O.D. When the dosage was increased severe ponding resulted accompanied by deterioration of the effluent. The shallow filters, designed for partial treatment to produce an effluent which could be treated on the deep filters, produced a purification of about 75 per cent of the B.O.D. basis with an application of 850 gal. a cu.yd. per day. Indications are that the limit has not yet been reached.

GAS STORAGE—Methods of gas collection and storage in use at sewage plants vary greatly. When the gas is utilized for heating purposes alone there is frequently no storage available, but when the gas is used for power production storage tanks are employed. With larger plants or when power consumption varies materially during the day proper gas storage with suitable pressures is of interest.

At a new plant built for the western part of the city of Helsingfors, Finland, Grangvist (*Gesundheits Ingenieur*, 639, 1938) the gas not immediately used for heat and power is stored in pressure tanks. Excess gas is passed through a condenser into two horizontal tanks 10 ft. in dia. with a capacity of 3,500 cu.ft. but holding 35,000 cu.ft. of compressed gas each. Stored gas is used at peak-loads and released through pressure regulators. A special mechanism has been built in the pipe leading to the compressors which gives an alarm when the pressure is reduced below 50 mm. The compressors are equipped with suction regulators which are set at 80 mm. pressure and when the pressure decreases back flow takes place. Provision is made to bottle the gas for vehicle use.

BIO-FILTRATION—Results on direct comparisons of biological filtration with low- and high-rate trickling filters on a large scale with settled sewage are scarce. For this reason the experiments conducted recently at Stuttgart over a period of several months are of considerable interest. (Sohler, *Gesundheits Ingenieur*, 61,-770, 1938). Low-rate filters at this place received an application of sewage equivalent to 300 gal. per cu.yd. of filter material, while the high-rate and bio-filtration units received 6 times this quantity. In the two-stage bio-filtration process half of the sewage was settled and the other half was effluent from a high-rate filter. After final settling the overall B.O.D. reduction of the low-rate filters was 91.7 per cent; returning the high-rate filter effluent produced a reduction of 92.9 per cent. When the sewage applied to the bio-filtration process consisted half of settled sewage and half of high-rate filter effluent, the B.O.D. reduction amounted to 91.7 per cent as compared to 93.8 per cent on the low-rate filters. It appears that with two-stage high-rate filtration any desired degree of purification may be accomplished.

LAKE AERATION—The possibilities of utilizing ponds and small lakes as adjuncts to sewage treatment plants has by no means been exhausted. To prevent such ponds from becoming foul, a floating pump which takes the water from the deeper parts and sprays it over the surface to increase the dissolved oxygen, has been employed with success abroad. (*Annual Report*, Wupperverband, 1938).

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

AUGUST construction material prices show only minor changes compared with those of a month ago. Short Leaf Yellow Pine is up $1.00 on the 2x10-in. size and off $1.00 on 3x12-in. size in Atlanta; off $1.00 to $2.00 on most sizes in Chicago; up 50c. on 1-in. sizes in St. Louis; and up $1.00 on the larger sizes in Detroit. Douglas Fir is $1.00 lower on 2x4- and 2x6-in. sizes in Detroit.

Portland cement prices are unchanged from July. Sand and gravel are up 1c. per ton in San Francisco. Crushed stone is off 4c. per ton, and ready-mixed concrete is 13c. per cu. yd. higher in San Francisco.

Cincinnati price on structural shapes, $3.48 per 100 lb., is 40c. lower than last month. Reinforcing steel is down 25c. per 100 lb. in St. Louis.

Prices for 40% Ammonia Gelatin explosives (other than Seismograph grades) is 1c. per lb. lower in other-than-urban areas throughout the country, but up 1c. per lb. in Atlanta.

Structural clay partition tile price in Minneapolis has been unsettled since the July quotations, and at the present time no price is available.

Hoisting engineers' rate in Boston, formerly $1.375 per hour, now ranges from $1.375 to $1.625, the latter being the union scale. Their new rate in Los Angeles, $1.375 per hour, is an increase of 25c.

Common labor on heavy construction in Kansas City now receives 50c. per hour, closing up the range of 45 to 50c. that previously prevailed.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.65	$2.60	$1.75	$1.85	$1.95	$1.65	$1.75	$1.55	$1.65	$7.90
Baltimore	2.31	2.06	1.86	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	6.50
Birmingham	2.50	2.25	2.05	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.75*b*	2.50*b*	2.30	1.10‡	1.10‡	.80‡	1.10‡	1.10‡	....	....	6.75*m*
Chicago	2.75	2.50	2.35	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	1.25‡	1.25‡	....
Cincinnati	2.58	2.33	2.08	1.20	1.20	1.30	1.80	1.80	....	....	6.60
Cleveland	2.29	2.04	....	1.45*i*	1.45*i*	1.45*i*	1.60*i*	1.60*i*	1.70*i*	1.70*i*	6.85*i*
Dallas	2.30	2.05	1.85	2.00*p*	2.00*p*	1.50*p*	1.69*p*	1.84*p*	....	....	6.20
Denver	3.02	2.77	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.15	1.90	1.70	1.30	1.40	.80	1.45	1.45	1.14‡	1.14‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.90*n*
Los Angeles	2.82*b*	2.62*b*	....	1.00	1.00	1.00	1.00*f*	1.00*f*	....	....	5.85
Minneapolis	3.00	2.75	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.35*j*
Montreal	....	....	1.48	....	....	1.25‡	.90‡*c*	1.00‡*c*	....	....	7.60*k*
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.60‡	2.35‡	....	1.40*de*	1.40*de*	.90*de*	1.65*de*	1.75*de*	....	....	7.25
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	....	....	1.00	1.00	7.95*k*
Pittsburgh	2.44	2.19	1.99	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.55	2.30	....	1.50‡	1.50‡	1.25/1.50‡	.85*h*	.85*h*	.75*g*	.75*g*	7.50
San Francisco	2.72	2.52	2.20	1.36	1.36	1.36	1.46	1.46	....	....	7.63
Seattle	2.95*o*	2.70*o*	....	1.00*o*	1.00*o*	1.00*o*	2.00*o*	2.00*o*	....	....	7.50*o*

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Plus municipal tax. *d* Per cu. yd. *e* Barge lots alongside docks miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice, in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk.
Buffington, Ind	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn	$1.80	$1.75
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.70	1.65	Steelton, Minn	1.80	1.75
Hannibal, Mo	1.70	1.65	Norfolk, Va	1.65	1.60	Universal, Pa	1.65	1.60
Hudson, N. Y	1.75	1.70	Northampton, Pa	1.55	1.50	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans	1.70	1.65	North Birmingham, Ala	1.70	1.65			

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OILS	ASPHALT EMULSION (Quick-breaking)
	Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Per ton, less than 80 penetration		Per gal. 80–300 penetration		Per ton		Per gal.	Per gal.
				Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$75.00	$39.35	$2.25	$16.60*e*	$21.80*e*	$0.0675*e*	$0.0968*e*	$0.0734*he*	$0.1053*he*	$0.0583*e*	$0.0834	$0.0834
Baltimore	140.00‡	44.00‡	2.50	13.00	18.00	.05	.08	.06*h*	.09	.....	.....	.....
Birmingham	.....	25.00	.....	18.20	23.40	.0747	.1047	.0834*h*	.1134*h*	.....	.....	.....
Boston	80.00	47.00	3.00	13.00	19.00	.05	.08	.06*h*	.09*h*	.....	.09‡	.12‡
Chicago	140.00	52.00	2.50	14.00	18.00	13.00*g*	17.00*g*	.055	.105	.0275	.08	.12
Cincinnati	112.00	37.50	.....	14.31	18.31	.10	.....	18.00	.....	.0525	.....	.08
Cleveland	110.00	37.25	2.80	15.25	20.50	.07	.08	.07*h*	.085*h*	.04	.08	.09
Dallas	.....	30.00	.....	12.00	17.00	.04	.07	13.00	18.00	.035	.05/.07	.07/.09
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	13.60*f*	18.00*f*	.0593	.0994	13.60	18.00	.0535	.0567	.0924
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	6.50*b*	15.00	6.50*b*	15.00*g*	5.50*b*	.....	.0192	.0525	.1125
Minneapolis	.....	.....	1.90*d*	19.20	24.20	.10	.12	19.30	28.30	.056	.....	.....
Montreal	82.00	.....	3.62	14.60	21.25	.105	.1375	.101*h*	.121*h*	.0935	.13	.16
New Orleans	.....	.....	.....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	.....	.078	.....
New York	.....	68.00	2.70	13.50	18.50	.055	.08	.06*h*	.09*h*	.....	.07	.10
Philadelphia	120.00	42.50	2.84	14.00	19.00	.055	.08	.06*h*	.09*h*	.05	.06	.09
Pittsburgh	115.00	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	110.00/121.00	37.00	.....	14.00	19.00	.055	.085	.06*h*	.09*h*	.0375	.085	.12
San Francisco	.....	70.00	.....	6.50	15.00	6.50*g*	15.00*g*	7.00	17.50	.025	.0475	.117
Seattle	.....	60.00*c*	.....	13.75	23.55	.....	25.15*g*	10.15/11.15	23.65/24.65	8.40*g*	.0575	.1308

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon.

(Continued on page 80)

LAY-SET Preformed WIRE ROPE —Economizer

GREEN SIGNIFIES SAFETY

Wherever it is necessary to have economy of operation, increased service from machinery, greater speed of production, or increased safety to workmen—there LAY-SET Preformed Wire Rope is most appreciated.

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BUY ACCO QUALITY *whether for Hazard Wire Ropes —American Chains (Weed Tire Chains—Welded or Weldless Chain)—Campbell Abrasive Cutting Machines —Page Chain Link Fence—Page Welding Wire—Reading-Pratt & Cady Valves—Wright Hoists or any other of the 137 ACCO Quality Products.*

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ABSTRACTS AND NOTES

Groundwater Flow Through Sand

Studies of groundwater profiles and of lateral movements of water through sandbeds assume usually that the horizontal component of velocity is constant and proportional to the slope of the profile, but observations have revealed inconsistencies which suggested a laboratory investigation as to percolation and capillary movements of water through sand. This investigation, conducted by Prof. F. T. Mavis and Tsung-Pei Tsui is described in Bulletin 18 of "Studies in Engineering", University of Iowa. Besides new formulas the following conclusions are presented:

1. The shape of the piezometric groundwater profile connecting two fixed points in a sand prism for lateral seepage flow is independent of the gradation of the material.

2. The water in the capillary fringe moves with the gravity water in the main body of a permeable material and its average velocity is approximately two-thirds the velocity of the gravity water. This movement cannot be overlooked in model studies, though it may have little significance in field practice.

• • •

Concrete Pontoon Bridge Laid Out On a Curve

A bridge designed to span the River Derwent at Hobart, Tasmania, uses cellular concrete barges arranged on a curved alignment to avoid the necessity for anchoring the structure against tidal currents. On ebb tide the barges become voussoirs of a three-hinged arch and are under compression; on flood tide the structure becomes a "horizontal suspension bridge", with the connections between the barges put in tension by the force of the current.

The chord between abutments has a length of 3,063 ft. and the roadway is curved uniformly on a radius of 2,742 ft. There is a conventional lift span just behind the abutment at one end. The pontoon structure was designed to take a 6-ft. tidal fluctuation with heavy winds and ice; it has a roadway 30 ft. wide and a 6-ft. sidewalk. Pontoons are 138½ x 40½ ft., overall, in plan, with 8-in. heavily reinforced exterior walls. Interior walls (two longitudinal and four transverse) are 5 to 7 in. thick. The overall height is 12 ft. and the normal draft 6 ft. 8 in.

At both ends of each pontoon the side walls and bottom are extended like the lower half of a pipe bell-end. As adjacent pontoons are brought into position, these projections, with rubber gaskets between, are bolted together to form watertight compartments between the pontoons proper. These compartments are then unwatered to permit welding projecting steel of adjoining barges, thus making rigid connection and forming a continuous structure.

At each abutment a pair of structural steel links, 41 ft. long, connect the end pontoon to the abutment pin. Pins are used at both ends of these links to form a double-hinged connection that will allow for tidal variations as well as for transverse list.

• • •

Iron Removal With Lignin

Lignin, which can be obtained from corn cobs, cornstalks and waste from wood pulp mills, is "very efficient" in removing iron from water, chemists at the Federal Agricultural By-Products Laboratory, Ames, Iowa, state.

It is reported by D. F. J. Lynch, Max Levine, and G. H. Nelson that lignin was found to be more effective as an iron remover than a widely employed inorganic iron-removing compound. The efficiency of the inorganic compound was said to drop precipitously after the sixth reuse, but lignin showed no decrease in efficiency even after the tenth reuse. The inorganic compound was more efficient in removing ferric than ferrous iron, but lignin was equally efficient with both.

Lignin has been manufactured from farm wastes only in the laboratory, but it is thought the commercial recovery is possible at a low cost. Cornstalks contain 15 to 25 per cent lignin, and wood pulp, 25 per cent.

The chemists state that "it may be feasible to utilize lignin in conjunction with existing water filtration plants by adding the powdered lignin to the water in the mixing and sedimentation tanks or applying it to the water as it enters the filters in a manner analogous to the employment of activated carbon for odor removal."

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STANDARD OIL COMPANY OF CALIFORNIA

(Continued from page 76)

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std. Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.10	$2.05	$3.40	$2.40	....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago	2.10	2.05	3.40	2.40	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Pittsburgh	2.10	2.05	3.40	2.40	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo	2.10	2.05	....	....	2.40	....	....	....	....	....	2.15	....
Cleveland	2.10	2.05	3.40	2.40	....	....	....	....	....	....	....	....
Youngstown	....	2.05	....	....	....	....	....	....	....	3.00	....	....
Detroit	....	2.15‡	....	....	....	....	....	....	....	....	....	....
Gulf ports	2.45*a*	2.40*a*	....	....	2.85*a*	....	....	....	....	....	....	....
Pacific ports	2.70*a*	2.50*a*	....	....	2.90*a*	....	....	....	....	3.00	2.25	....

‡ Delivered. *a* F.o.b. cars dock. *b* For rail steel deduct 15c. from billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH—Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING—Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$2.34	$2.04	$1.94	.02½	.10	$21.00	$23.00	$1.70	$1.28	$0.1604	$3.04
Baltimore	3.55	2.70	2.55	....	.10	21.00	23.00	1.58	1.20	.1496	2.70
Birmingham	2.10*a*	2.05	1.90	.02½	.10	19.50	21.50	1.68	1.26	.1586	....
Boston	3.85	2.58	2.43	$20 C.L.	.10	20.00	22.00	1.64	1.24	.1550	2.99
Chicago	2.10*a*	2.05	1.90	.03	.05	18.50	20.50	1.55	1.18	.1460	2.40
Cincinnati	3.48	2.31*c*	2.16*c*	.....	.05	20.50	22.50	1.54	1.17	.1451	....
Cleveland	3.58*g*	2.05	1.90	.02½	.10	20.50	22.50	1.54	1.17	.1460	....
Dallas	4.15	2.80	2.65	.....	.....	25.00	27.00	1.81	1.35	.1712	....
Denver	4.21	3.89	3.74	.....	.....	23.50	25.50	1.85	1.37	.1748	....
Detroit	3.65‡	2.45	2.30	.....	.10	22.50	24.50	1.56	1.19	.1478	2.66
Kansas City	4.03	2.51*c*	2.36*c*	.0	.05	18.50	20.50	1.66	1.25	.1577	2.86
Los Angeles	3.50*f*	2.65	2.50	.02½	.05	23.00	27.50	1.81	1.35	.1712	3.50
Minneapolis	3.80‡	2.38*c*	2.23*c*	.0	.10	21.50	24.50	1.68	1.26	.1586	2.73*d*
Montreal	3.25	2.65	2.55	.....	.....	26.68	29.90	3.03	2.11	.3178	3.95
New Orleans	3.90	2.69	2.54	.05	.10	21.50	23.50	1.71	1.29	.1522	2.875
New York	3.75	2.29	2.14	.....	.10	20.50	22.50	1.60	1.22	.1514	2.74
Philadelphia	3.40	2.37	2.22	.....	.....	20.50	22.50	1.59	1.21	.1505	2.72
Pittsburgh	2.10*a*	2.05	1.90	.02½	.10	21.50	24.50	1.47	1.13	.1388	2.40
St. Louis	3.47	2.04	1.94	.0	.05	20.50	24.50	1.57	1.19	.1487	2.70
San Francisco	3.45	2.50	2.35	.02½	.10	23.50	25.50	1.81	1.35	.1712	3.00
Seattle	2.70*e*	2.40*e*	.....	.....	.....	25.50	27.50	1.81	1.35	.1712	2.90*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 30c.; 1 to 5 tons, add 10c.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE Per foot, 8 in., s.s.	delivered 12 in., s.s.	ASTM 24 in., d.s.	C13–35 36 in., d.s.	CLAY DRAIN TILE Per 1,000 ft., carload lots, 6 in.	f.o.b. 8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$46.40	$0.26*bc*	$0.468*bc*	$1.69	$4.50*c*	$85.00	$128.00	$0.45	$1.625	62.2	54.2	59.7	51.2
Baltimore	49.80	.30	.55	2.30	6.80	110.00	150.00	.40	1.60	65.5	57.5	63.0	54.5
Birmingham	42.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston	52.00	.245	.4725	1.98	5.535	166.50‡	240.00‡	.45	2.30	64.1	56.1	61.6	53.1
Chicago	50.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati	49.70	.231	.4455	1.755	5.2275	75.00	120.00	.60	1.90	65.9	57.9	63.4	54.9
Cleveland	51.24	.224	.432	1.665	5.0225	69.00	108.00	.35	1.50	67.8	59.8	65.3	56.8
Dallas	55.20	.265	.477	1.728	4.70'	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver	57.60	.24†	.52†	2.16†	.....	130.00	240.00	.....	.....	58.4	50.4	55.7	47.2
Detroit	51.24	.147	.2835	1.215	4.70	66.45	111.40	.25	1.125	66.3	58.3	63.8	55.3
Kansas City	52.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles	52.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	56.8	47.8	54.3	44.8
Minneapolis	54.20	.24†	.432†	1.728†	4.60†	.....	.....	.70	1.80	64.2	56.2	60.7	52.2
Montreal	60.00	.59	.90	3.15	5.10*e*	135.00‡	260.00‡	.48	1.92	.....	.....	.....	.....
New Orleans	48.38	.26	.48	1.69	.....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York	49.20	.32	.63	2.52	6.45	.....	.....	.50	1.20	64.9	56.8	62.4	53.9
Philadelphia	47.90	.21	.405	1.75	5.05	100.00	160.00	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh	52.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85*g*	2.00*g*	68.5*i*	60.5*i*	66.0*i*	57.5*i*
St. Louis	49.48	.26	.468	2.016	3.96	85.00	160.00	.80	2.00	65.1	57.1	62.0	53.5
San Francisco	52.00	.3275*d*	.5895*d*	2.358	5.895	107.25	178.75	.45	2.50	.....	.....	.....	.....
Seattle	52.35	.35	.63	2.52	6.30	72.00	175.00	.50*f*	1.40*f*	.....	.....	.....	.....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N. J. (base) $46.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¾ in., 8½c.; 1 in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld — 1 in. and 1¼ in. black 34, galv. 19; 1½ in. black 38, galv. 21½; 2 in. black 37½, galv. 21. Lapweld — 2½ in. to 3½ in. black 31½, galv. 17½ in.; 4½ in. to 8 in. black, 32½ galv. 20.

(Continued on page 82)

Owned by J. A. Terteling & Sons and operating near Gothenburg, Nebraska, this New Bucyrus-Monighan 9-W uses a 160-foot boom.

BUCYRUS-MONIGHAN

9-W

WALKING DRAGLINE

BUCYRUS MONIGHAN

Bucyrus-Erie

SOUTH MILWAUKEE, WISCONSIN

(Continued from page 80)

LUMBER, TIMBER, PLYWOOD—PER M FT. B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base prices)	
	All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)											5/8"	3/4"
	1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10, S4S	3x12, R&h	6x12, R&h	12x12, R&h	2x12, R&h	12x12, R&h		
Atlanta	**$19.00**	**$19.00**	**$18.50**	**$19.00**	**$19.50**	**$21.00**	**$26.00**	.....	.....	$38.50	$50.50	$17.75	$21.60
Baltimore	**24.00**	**25.00**	**24.00**	**25.00**	**26.00**	**27.00**	**39.00**	.....	.....	68.00	70.00	17.35*g*	21.15*g*
	31.00	*31.00*	*31.00*	*31.00*	*31.00*	*31.00*	*39.00*	*$39.00*	*$39.00*	.....	.....	.....	.....
Birmingham	**19.00**	**19.00**	**19.00**	**19.00**	**19.00**	**20.00**	**30.00**	**30.00**	**30.00**	.....	.....	16.25	19.85
[1]	22.00	22.00	26.00	26.00	26.00	36.00	54.00	.....	.....	48.00	53.00	.....	.....
Boston	**26.00**[2]	**26.00**[2]	**30.00**[3]	**32.00**	**32.00**	**48.00**[1]	**55.00**[1]	**72.00**[1]	.....	.....	.....	72.00	72.00	17.35*g*	21.15*g*
	26.00	*26.00*	*30.00*	*32.00*	*32.00*	*34.00*	*40.00*	*40.00*	*40.00*	.....	.....	.....	.....
Chicago	**28.00**	**28.00**	**30.00**	**30.00**	**31.00**	**31.00**	**45.00**	.....	.....	75.00	85.00	13.15	16.05
	33.00	*33.00*	*34.00*	*34.00*	*35.00*	*35.00*	*40.00*	*40.00*	*40.00*	.....	.....	.....	.....
Cincinnati	**23.75**	**23.75**	**25.00**	**23.50**	**24.50**	**26.50**	**37.50**	.....	.....	46.00	49.00	16.25	19.85
	.....	.....	.....	.....	.....	.....	*39.50*	*39.50*	*39.50*	.....	.....	.....	.....
Cleveland [f]	**29.00**	**29.00**	**27.50**	**28.00**	**29.50**	**31.00**	**41.00**	45.00	45.00	50.00	60.00[3]	16.65	20.25
Dallas [e]	**28.50**	**32.00**	**31.50**	**28.50**	**30.00**	**32.50**	**53.50**	**52.50**	**52.50**	63.50	71.00	13.90	16.95
Denver [‡]	39.00[4]	38.00[4]	39.00[4]	42.00[4]	47.00[4]	41.00[4]	48.00[4]	60.00[4]	71.50[4]	.....	.....	9.90	12.05
Detroit	**28.00**	**28.00**	**29.00**	**27.00**	**31.00**	**34.00**	**37.00**	.....	.....	31.00	43.00	16.25	19.85
	.....	.....	.....	*36.00*	*36.00*	*37.00*	*38.00*	*43.00*	*43.00*	.....	.....	.....	.....
Kansas City	**27.00**	**28.50**	**28.00**	**26.00**	**28.00**	**30.00**	**35.00**	.....	.....	35.00	48.00	12.25	14.95
	28.00	*28.00*	*28.00*	*28.00*	*28.00*	*29.00*	*34.00*	*35.00*	*35.00*	.....	.....	.....	.....
Los Angeles [a]	*35.00*	*35.00*	*35.00*	*35.00*	*36.00*	*36.00*	*42.00*	*46.00*	*42.00*	.....	.....	9.35*gh*	11.35*gh*
Minneapolis [‡b]	43.00[5]	43.00[4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.05	14.70
[‡]	*34.00*	*34.00*	*35.00*	*35.00*	*35.00*	*35.00*	*55.00*	*55.00*	*55.00*	.....	.....	.....	.....
Montreal [7]	*45.00*	*45.00*	*49.00*	*47.00*	48.00	58.00	84.00	.....	.....	135.00	145.00	.....	.....
	40.00	*40.00*	*40.00*	*40.00*	*40.00*	*41.00*	*42.00*	*41.00*	*40.00*	.....	.....	.....	.....
New Orleans	**22.00**	**22.00**	**20.00**	**19.00**	**20.00**	**22.00**	**42.00**	.....	.....	58.00	65.00	13.90	16.95
	26.00	*26.00*	*28.00*	*29.00*	*32.00*	*30.00*	*32.00*	.....	.....	.....	.....	.....	.....
New York [‡]	**36.00**	**37.00**	**35.00**	**36.00**	**36.00**	**37.00**	**42.00**	.....	.....	77.50	80.00	17.35*g*	21.15*g*
[‡]	.....	.....	*40.00*	*40.00*	*40.00*	*40.00*	*40.00*	*42.50*	*42.50*	.....	.....	.....	.....
Philadelphia	**23.50**	**24.00**	**25.00**	**25.00**	**26.00**	**26.50**	**28.50**	.....	.....	54.00	56.00	17.35*g*	21.15*g*
	34.00	*35.50*	*38.00*	*37.25*	*36.50*	*36.50*	*41.75*	*31.50*	*31.50*	.....	.....	.....	.....
Pittsburgh	**38.10**	**39.90**	**47.05**	**42.00**	**45.65**	**46.90**	**59.70**	.....	.....	.....	.....	17.00	20.70
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....	.....
St. Louis [‡c]	**31.00**	**32.50**	**30.00**	**29.00**	**30.00**	**31.00**	**46.00**	*51.00*	*51.00*	72.00	71.00	13.90	16.95
San Francisco [d]	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*23.00*	*23.00*	*23.00*	.....	.....	7.30*g*	8.90*g*
Seattle	*20.00*	*20.00*	*20.00*	*20.00*	*20.00*	*20.00*	*25.00*	*25.00*	*25.00*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Pine. [‡] Norway Pine. [‡] Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off.

NOTE: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on 5/8", $74.00; on 3/4", $81.50; price includes oiling and sealing charges. For other centers add rail freight increment from table for proper size. For resin dipped treatment, add $10.00 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Sept. 15, 1928 Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	88%*d*	88%*d*	$0.15
Baltimore	83%*d*	82%*d*	.15
Birmingham	89%	90%	.105
Boston	82%*d*	82%*d*	.15
Chicago	79%*d*	79%*d*	.15
Cincinnati	79–10%*d*	79–10%*d*	.15
Cleveland	88–10–10%	88–10–10%	.19
Dallas	80%*d*	80%*d*	.165
Denver	76–10%*d*	76–10%*d*	.15*e*
Detroit	79–10%*d*	79–10%*d*	.15
Kansas City	79–10%*d*	79–10%*d*	.155
Los Angeles	88%*a*	90%*a*	.1575
Minneapolis	76%*d*	76%*d*	.155
Montreal	70–10%*b*		.17†
New Orleans	80%*d*	80%*d*	.16
New York	82%*d*	83%*d*	.20*f*
Philadelphia	89–10%	90–10%	.15
Pittsburgh	79%*a*	79%*a*	.1425
St. Louis	79–10%*d*	79–10%*d*	.155
San Francisco	78%*d*	83%*d*	.155
Seattle	85%	88%	.1575

Price of 60% Ammonia Gelatin is $0.015 per lb. higher than 40%

a Disc. from list Sept. 15, 1938 *b* Also less 6% tax exemption. *d* Discount from jobbers' list Aug. 15, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla	$0.105	$0.14	$0.16
W. of Miss., to Rocky Mtn. States, and Fla	.11 –.12	.135 –.15	.155 –.17
Rocky Mtn. States	.11 –.1325	.13 –.145**	.15 –.165**
Pacific N. W. States	.1075–.115	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1175	.135 –.1475	.155 –.1625

** F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf — Barge	Short Leaf — Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.18	$0.195
12 in.— 2 ft. from butt	6 in.	50 to 59 ft.	.225	.24
12 in.— 2 ft. from butt	6 in.	60 to 69 ft.	.23	.255
14 in.— 2 ft. from butt	6 in.	50 to 69 ft.	.24	.265
14 in.— 2 ft. from butt	6 in.	70 to 79 ft.	.28	.275
14 in.— 2 ft. from butt	5 in.	80 to 85 ft.	.40	.415
14 in.— 2 ft. from butt	5 in.	85 to 89 ft.	.42	.432

RAILWAY TIES

Prices f.o.b., per tie for carload lots:		6" x 8" x 8' Untr.	6" x 8" x 8' Tr.	7" x 9" x 8'6" Untr.	7" x 9" x 8'6" Tr.
Boston	Oak	$1.10	....	$1.60	....
	Pine	1.40	$2.10*a*	2.10	$3.00*a*
New York	S. L. Sap Pine	1.05/1.15	1.80	1.45	2.35
	Mixed Oak	1.35	1.90	1.85	2.45
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	....	2.40*a*
St. Louis	White Oak	1.00	....	1.43	....
	Red Oak	1.00	1.50*a*	1.43	1.98*a*
	Sap Pine or Cypress	.90	....	1.33	....
San Francisco	Douglas Fir	.80*bef*	....	....	1.85*cef*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6" x 8" x 8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.00-2.85
Chlorine cylinders, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, delivered, per ton	22.00-35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb	4.25

(Continued on page 84)

The Tops in Economy "FLEX-SET" PREFORMED YELLOW STRAND

Cast up the final cost—the REAL cost—of "Flex-Set" Preformed Yellow Strand, and you will find it the most economical of all wire ropes. Use where jobs are toughest. That's what it's made for—hard work!

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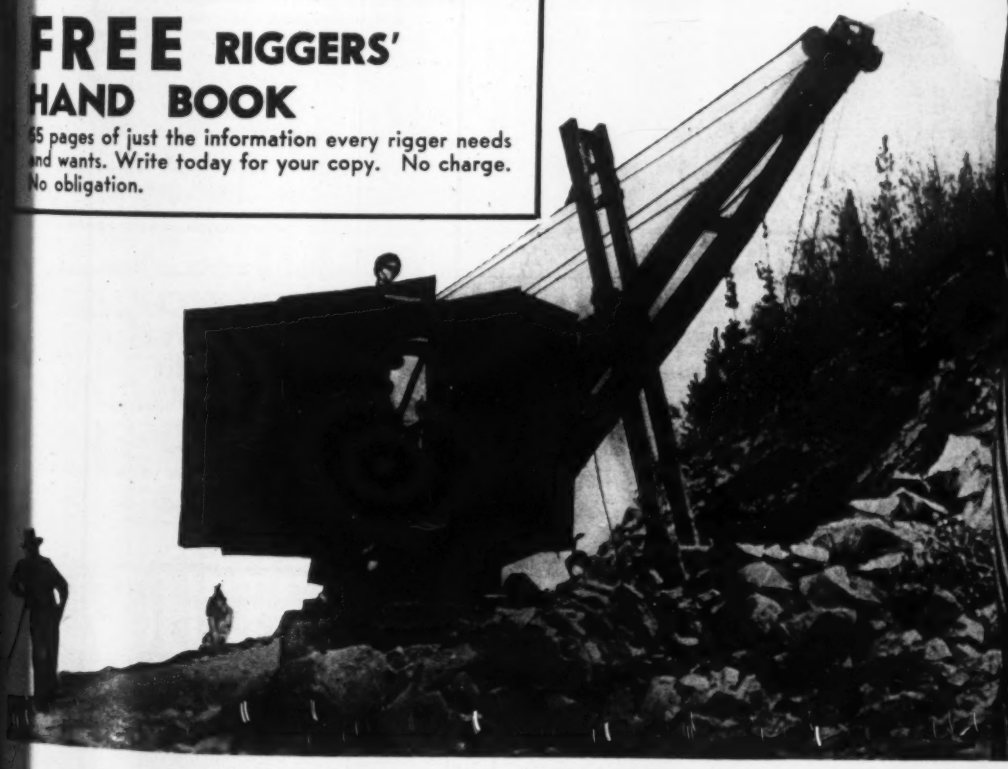


(Continued from page 82)

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over, 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity. Common backing	Straight hard	LIME Per ton, Hydrated finishing	In paper Common hydrated	Carload lot Pulverized or lump
Atlanta	$90.00	$100.00	$185.00	$220.00	$230.00	$240.00	$12.50	$16.00	$24.00	$15.50	$15.50
Baltimore	74.00	80.00	165.00	190.00	240.00	290.00	13.00*k*	16.00*k*	18.00	14.00	2.45*m*
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	3.00*o*	1.75*o*	2.25*p*
Boston	90.95*ab*	96.95*ab*	181.80*ab*	206.05*ab*	276.65*ab*	316.15*a*	17.00*i*	20.00*i*	20.00	13.00	2.65*p*
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	11.00	12.00	16.40	14.40	12.20
Cincinnati	61.40	65.30	121.20	141.50	187.30	215.20	16.00	16.00	15.90	13.00	.....
Cleveland	54.50	58.00	109.00	130.50	175.50	200.50	16.00	16.00	16.80*j*	14.00*j*	2.75*j*m
Dallas	62.50	67.50	135.00	162.00	177.00	263.00	11.50*i*	13.50*i*	19.00	15.00	95*n*
Denver	84.80	95.40	152.70	178.20	212.00	227.90	13.50	17.00	28.00*j*	17.00*j*	35.00*j*
Detroit	68.90	73.50	137.80	175.50	232.00	265.00*e*	16.00	17.00	13.50	11.75	12.75
Kansas City	64.50	66.50	86.00*c*	125.50	159.75	186.25	14.00	24.00	19.10	12.80	10.70
Los Angeles	73.50*tr*	89.50*tr*	128.00*ctr*	210.00*tr*	368.00*tr*	460.00*tr*	13.00	15.00	16.50	.....	17.50
Minneapolis*	.....	.....	.....	.....	.....	.....	13.10	15.10*g*	21.00	16.00	19.00
Montreal	64.00*a*	77.00*a*	141.00*at*	77.00*a*	128.00*a*	.....	21.00	31.00	24.60	16.00	1.75*o*
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	87.00	93.00	128.00	193.30*h*	238.80*h*	295.60*h*	13.50	.....	20.00	14.00	18.00
Philadelphia	77.40	82.50	154.50	185.70	229.90	284.60	11.00*s*	18.00*s*	15.50*q*	10.05	10.55
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.90	15.40	2.55*m*
St. Louis	62.00	65.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30*m*
San Francisco	84.00	94.50	225.00	.....	.....	.....	14.00	17.00	.55*o*	.40*o*	2.05*m*
Seattle	100.00	110.00	220.00	.....	.....	.....	17.50*f*	17.50*f*	20.00*s*	20.00*s*	20.00*s*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6 x 12 x 12 in. *d* Not load bearing. *e* 48 lb. tile. *f* Less $1.00, ½ cash 15 days, balance 30 days. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* 50c per M. off for cash. *j* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb. *n* Per sack 100 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *q* 15-ton cars. *r* 5% discount 10 days. *s* 2% off cash. *t* 5½ x 8 x 12. *No August price available

PAINT, ROOFING—F.O.B. CARLOAD LOTS

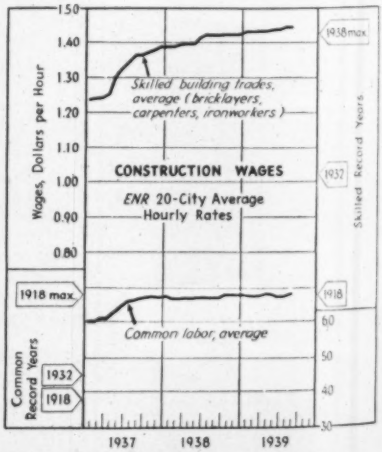
	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl. per ton
Atlanta	$8.50	$12.625	$1.30	$2.25	$1.20	$1.71	$1.65	$1.65	$0.36	$26.00
Baltimore	8.25	12.25	1.60	2.40	1.90	2.16	2.75	2.75	.40	27.50
Birmingham	8.50	12.625	2.35	2.35	1.85	1.84	1 73	1.73	.45	27.00
Boston	8.25	12.25	1.70‡	2.20‡	1.80‡	1.70‡	1.80*h*‡	1.80*h*‡	.40‡	20.00‡
Chicago	8.25	12.25	1.88	2.53	1.56	1.65*hf*	1.49*hf*	1.49*hf*	.26*f*	21.00*f*
Cincinnati	8.25	12.25	1.45	2.50	1.40	2.40	2.39*h*	2.39*h*	.36	21.00
Cleveland	8.25	12.25	1.90	2.60	1.40	1.50	1.50*h*	1.50*h*	.35	21.00
Dallas	8.25	13.00	1.80	1.95	....	2.75*h*	2.50*h*	2.50*h*	.60	....
Denver	8.75	12.75	....	....	....	2.45	4.00	3.00	.35	18.00
Detroit	8.25	12.25	2.00	3.00	1.75	2.40	3.00	3.00	.35	27.50
Kansas City	8.25	12.375	2.15*g*	2.40*g*	1.67*g*	1 93	2.09	2.09	.25	25.00
Los Angeles	8.50	12.75	1.60	2.25	2.30	2.10	1.50	....	.45	....
Minneapolis	8.25	12.375	....	....	....	1.50*i*	1.50*hi*	1.50*hi*	.29	21.00
Montreal	9.75	9.00	2.25	2.80	2.35	3.05	1.85	2.15	.95	10.80*k*
New York	8.25	12.25	1.80	2.45	1.48	1.50	1.45*h*	1.45*h*	.23	24.00
Philadelphia	8.25	12.25	....	....	....	1.92*e*	1.99*he*	1.99*he*	.41*e*	21.00
Pittsburgh	8.25	12.25	1.05	1.95	.80	1.95	1.94*h*	1.94*h*	.34	26.00
St. Louis	8.25	12.25	1.70/1.90	2.50/2.75	1.50/1.90	1.50	1.40	1.35	.23	21.00
San Francisco	8.50	12.50	1.80	2.75	1.10/2.00	1.66	1.90	1.90	.325	20.50
Seattle	8.50	12.75	1.80	3.00	2.20	2.35	1.46/2.14	1.95	.63	24.75*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* 550 lb. barrel.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.25	$1.00	$1.375	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.50	1.25	1.65	1.50	1.25	.5625	.5625
Birmingham	1.50	1.125	1.25	1.125	1.00	.30/.40*a*	.30/.40*a*
Boston	1.50	1.375	1.50	1.375/1.625	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.70	1.70	1.025	1.025
Cincinnati	1.625	1.45	1.525	1.00/1.525	1.625	.60/.75	.60/.75
Cleveland	1.625	1.375	1.50	1.50/1.75	1.50	.90	.90
Dallas	1.50	1.00	1.25	1.00	1.50	.40/.50	.40/.50
Denver	1.65*b*	1.50*b*	1.43*b*	....	1.50*b*	.718*b*	.718*b*
Detroit	1.50	1.25	1.50	1.50	1.55	.60/.75	.60/.75
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.50
Los Angeles	1.25	1.10	1.375	1.375	1.50	.625	.625
Minneapolis	1.375	1.25*d*	1.50	1.40	1.50*e*	.85	.85
New Orleans	1.00	1.00	1.25	1.00	1.00	.40	.40
New York	1.90*b*	1.75*b*	1.925	2.00*b*	2.00*c*	1.031	.875/.95
Philadelphia	1.65	1.25	1.50	1.50	1.565	.60	.60
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.50	1.25	1.75	1.57/2.00	1.58	.45/.875	.45/.875
San Francisco	1.75*c*	1.25*f*	1.50	1.50	1.60*c*	.81	.65
Seattle	1.60*cc*	1.25	1.50*c*	1.50*c*	1.60*c*	.90*c*	.90*c*
Montreal	.80	.70	.75	.65	.80	.45	.40

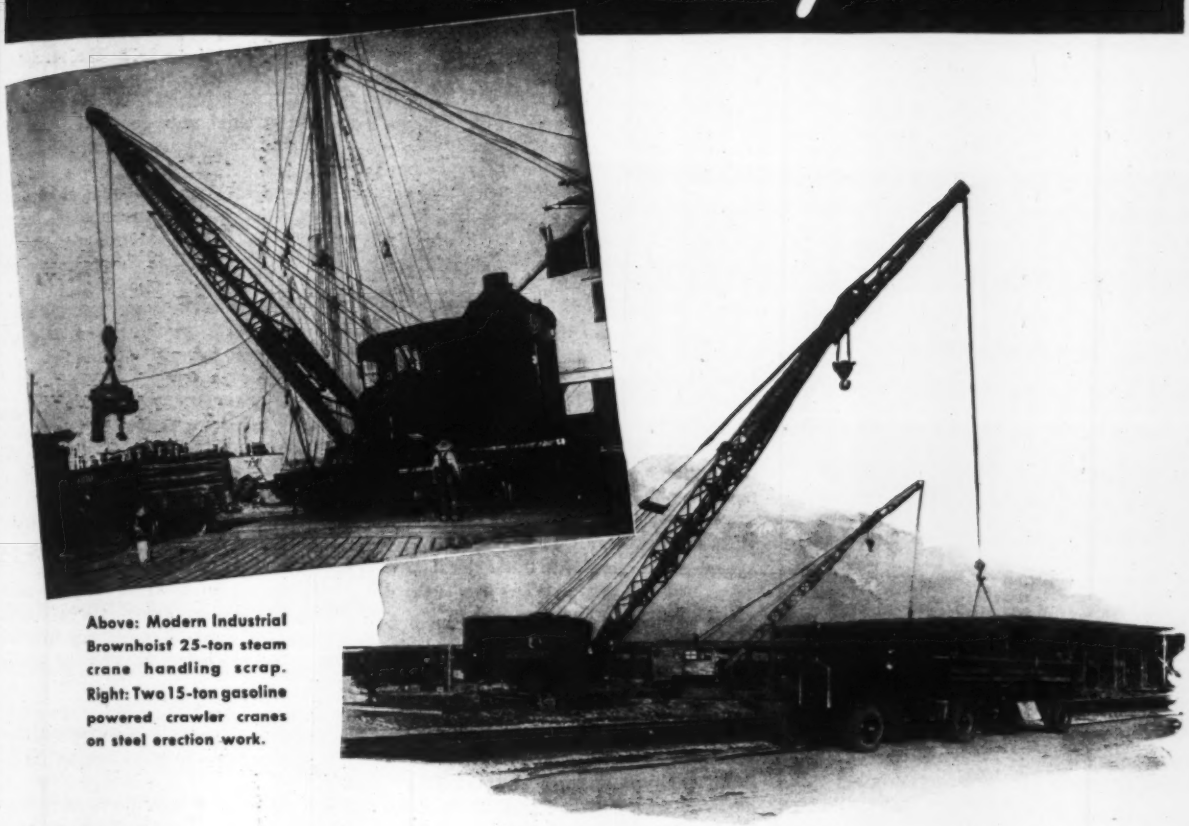
a PWA. *b* 7 hr. day. *c* 6 hr. day. *d* 35 hr. wk. *e* 30 hr. wk. *f* Working under "stop-gap" agreement.



ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.444

ENR Common Average: $0.685

ENGINEERED IN TUNE WITH *Today* . . .



Above: Modern Industrial Brownhoist 25-ton steam crane handling scrap. Right: Two 15-ton gasoline powered crawler cranes on steel erection work.

The work which a new Industrial Brownhoist locomotive or crawler crane will do on your job—the money it will save—can not be accurately estimated from the quality of materials used in its construction or the size of its engine. Call it modern engineering or what you will, the skillful co-ordination of details is what really makes an Industrial Brownhoist—makes it last longer, perform better and do more work.

In the past few years many new Industrial Brownhoists have replaced old cranes which still had years of good service left in them. In practically every instance they were purchased because we proved that an Industrial Brownhoist could save 25% to 50% over existing handling costs.

Would you like to know if such savings are possible in your plant? Our nearby sales engineer will gladly help you compile the data.

GAS AND DIESEL CRANES
10 to 50 tons capacity

STEAM LOCOMOTIVE CRANES
10 to 200 tons capacity

CRAWLER CRANES
up to 30 tons capacity

CLAMSHELL BUCKETS

INDUSTRIAL BROWNHOIST

BAY CITY, MICHIGAN

DISTRICT OFFICES: NEW YORK, PHILADELPHIA, PITTSBURGH, CLEVELAND, CHICAGO

IT'S THE FREE FLOATING DRIVE SHAFT THAT KEEPS YOUR STERLING PUMP TROUBLE FREE!

LET'S get a well's - eye view of one of the three big features that make Sterling Deep Well Turbine Pumps so trouble-free, so efficient, so long lasting.

Put a magnifying glass over the picture of that Sterling drive shaft. You'll see it is "*free floating*"—free to seek and follow its own best running position, free from strains upon the drive shaft bearings, free from the interference of bends and crooks! Because no attempt is made to center drive shaft in discharge column!

In addition, STERLING discharge columns, shaft enclosing tubes, and shafting as well as couplings are machine-cut threaded to insure a tight fit (no possible chance for water to contact threads). The entire pump has the advantage of precision assembly!

No wonder Sterling pumps are so trouble-free—but if you do need service, Sterling gives it—*from coast to coast!* Write us about your pumping problems—today.

STERLING PUMP CORPORATION
Hamilton, Ohio Stockton, Calif.

There are also Sterling Vertical Centrifugal Pumps, Sterling Sump Pumps, Sterling Propeller and Mixed Flow Pumps, and Sterling Jet Pumps. Precision Built . . . Yet Cost No More!

(Continued from page 39)

MEN AND JOBS

CHESTER V. ADAMS, senior engineer of the Idaho State Highway Bureau for the last ten years, has accepted a position as city engineer of Couer D'Alene. Adams will aid in rushing specifications for the city's new East End sewer project, costing over $190,000. He graduated in 1921 from Washington State College.

NICK F. HELMERS, formerly associated with Siems-Helmers, Inc., general contractors of St. Paul, has severed his connections with that firm to open a general contracting business in New York under the name of Nick F. Helmers, Inc. The new firm will handle construction of heavy foundations, cofferdams, under-water concreting, dams, hydroelectric plants, and river and harbor work.

JOHN J. STOBAUGH, JR., assistant in the Oklahoma State Highway Department for the past six years, has been named construction engineer to succeed W. CLAUDE SALE, who has resigned to accept a position with the federal government. N. B. TURNER has been named assistant construction engineer.

RUSSEL E. POTTER, city engineer of Nelson, B. C., for the past five years, has been appointed chief engineer for the city of New Westminster, B. C. He will have supervision of the city electric light, engineering and water works departments. He is a civil engineering graduate of the University of Saskatchewan and later studied electrical engineering at tthe University of Michigan.

SAM ROWE, superintendent of public works for the town of Newton, N. C., has resigned his post rather than take a salary cut.

THEODORE E. TRANSEAU, assistant director of public safety for the city of Philadelphia, has been named director of the division of highway safety of the Pennsylvania Department of Revenue. He is a graduate of the civil engineering college of the University of Pennsylvania.

GEOFFREY STEAD, for the past 18 years district chief engineer at St. John, N.B., and for 39 years engineer in the department of public works of Canada, has retired. In 1892, he was the first engineering graduate of the University of New Brunswick. He immediately went to work as a civil engineer on construction jobs in New Brunswick and Nova Scotia. He soon received an appointment with the Canadian public works department as divisional engineer in the St. John district. In 1921 he was made district chief at St. John, and played an important role in the construction of new docks in the St. John harbor. Although attaining the retirement age limit in 1937, he was retained as district chief until the completion of the harbor development at St. John.

GEORGE L. HALL, assistant chief and acting head of the bureau of sanitary engineering in the Maryland Department of Health, has been appointed chief. He has been associated with the department for 20 years and succeeds ABEL WOLMAN, who resigned as chief of the bureau several months ago.

H. STEWARDSON, city engineer and building inspector at New Westminster, B. C., has announced his decision to retire at the end of the year.

W. H. SINDT has been made director of operations of WPA in Oklahoma. He succeeds RAY V. LINDSAY. Sindt, formerly contractor at Enid, has been with the WPA several years. He was area engineer at Enid, then district director, and later assistant director of operations.

LEWIS E. MOORE, has announced that the engineering firm known as Moore & Haller, Inc., of Cambridge, Mass., is being liquidated and he is to resume his former independent consulting practice in Boston.

R. F. TURNER, formerly engineer for the WPA in the Yakima and Spokane zones of the state of Washington, has been named supervisor of operations in the Yakima zone to succeed WILLIAM KNOX; Knox takes a similar position in the Seattle area.

MAJ. E. M. GEORGE of the U. S. Army Quartermaster Staff at Washington, D. C., has been appointed construction quartemaster for the army construction works in Alaska. He will have charge of installing an experimental air station at Fairbanks, with surveys to begin next month.

ARMOUR T. GRANGER, for the last ten years assistant engineer with Ash, Howard, Needles & Tammen, consulting engineers, with offices at Kansas City and New York, has been appointed to the position of associate professor of civil engineering at the University of Tennessee. He will be in charge of instruction in concrete and steel design.

A graduate of the University of Texas in 1918, he was for eight years a member of the faculty of that institution.

RAYMOND REEVES of Denver has been appointed to the Colorado state highway advisory board, succeeding Warwick M. Downing.

CHRISTOPHER SHERMAN, for 43 years a professor of civil engineering at Ohio State University, recently resigned.

A. A. POTTER, dean of the Purdue University college of engineering, has received a four-year appointment as a trustee of the Engineering Foundation, an organization representing the principal engineering societies of America. The purpose of the foundation is "the furtherance of research in science and engineering, and the advancement in any other manner of the profession of engineering and the good of mankind." He is former president of the A.S.M.E. and of the American Engineering Council.

S. R. WESTON, a consulting engineer to the British Columbia Public Utilities Commission, has been made chief engineer for that body.

MEETINGS

FIFTH International Conference on Timber Utilization, Zurich, Switzerland, Aug. 29-31.

PUBLIC WORKS CONGRESS, annual meeting, Pittsburgh, Pa., Oct. 9-11.

REGIONAL AND LOCAL

AMERICAN WATER WORKS ASSOCIATION, section meetings: Minnesota, Duluth, Aug. 24-25; West Virginia, Morgantown, Sept. 27-29.

NORTH CAROLINA SOCIETY OF ENGINEERS, summer convention, Asheville, N. C., Aug. 4-5.

MINNESOTA Section, A.W.W.A., Duluth, Aug. 24-25.

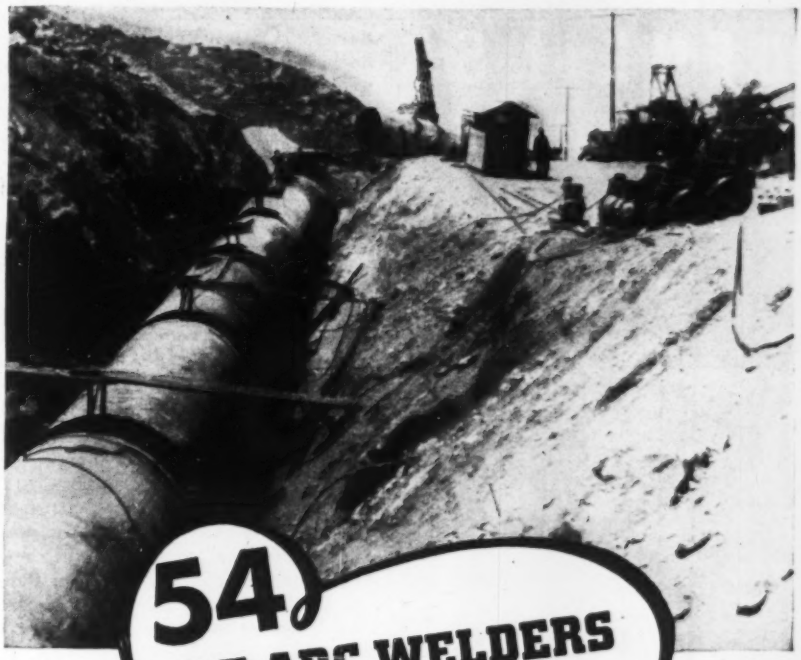
NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Hotel Windsor, Montreal, Sept. 12-15.

SOUTH DAKOTA WATER AND SEWAGE WORKS CONFERENCE, fifth annual meeting, Rapid City, Sept. 14-15.

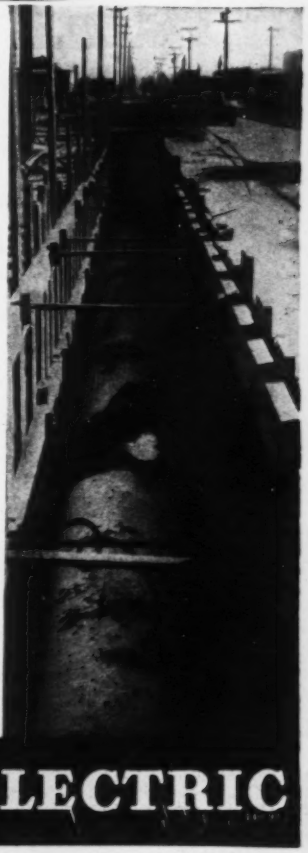
NORTH DAKOTA WATER AND SEWAGE WORKS CONFERENCE, Dickinson, N. D., Sept. 22-23.

ELECTIONS AND ACTIVITIES

Attendance numbered nearly 250 at the summer meeting of the Carolinas



54 G-E ARC WELDERS USED TO LAY HUGE PIPE LINE



THE Metropolitan Water District project required a ten-mile all-welded steel siphon across the Santa Ana River valley—part of the 242-mile Colorado River Aqueduct. The purpose of the project is to supply 13 cities of Southern California with 1,000,000,000 gallons of water per day.

To save time and make maximum speed in producing the high-quality welded joints specified by the contract, the pipe was shop welded with G-E automatic arc welders.

Likewise, in laying the pipe, the field welding was done with 54 G-E direct-current, single-operator arc welders equipped with remote control to save time in making current adjustments.

G-E Welders Benefit Contractors

This is but one example of how contractors in every part of the country are using G-E arc welders to advantage in pipeline work, building construction, power projects, etc.

Take full advantage of G-E arc-welding service, available locally through an authorized G-E arc-welding distributor, or write General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

JENKINS
IRON VALVES
COST LESS
TO USE!

Economy Features of this U-Bolt Gate

1 Perfect Grip Handwheel
2 Extra Deep Stuffing Box
3 Easily Cleaned Bonnet Chamber
4 Liberally Threaded Bronze Spindle
5 Renewable "Bonnet-Saver-Bushing"
6 Heavy Duty Bonnet and Body
7 Wide Gauge Reversible Wedge
8 Bronze Seat Rings—Expanded in
9 Iron Exceeds A.S.T.M. Standards
A TYPICAL JENKINS IRON VALUE —THERE ARE 101 OTHERS!
DIAMOND ANNIVERSARY
1864 1939
Fig. 42-A—150 lb. Bronze Mounted U-Bolt Gate Valve

JENKINS BROS., 80 White Street, New York, N.Y.
Bridgeport, Conn., Atlanta, Boston, Chicago, Houston, Philadelphia, Montreal, Canada, London, England

branch of the Associated General Contractors, Inc., July 21 and 22 at Blowing Rock, N. C. One item of discussion was whether or not the wages and hours law applies to general contracting in so far as overtime is concerned. The need for adjudication of this overtime question by the highest court was brought out.

JOHN KANGETER was elected president of the Engineering Association of Hawaii at its annual meeting early in July. Joseph K. Kunesh was elected first vice-president and Albert A. Wilson chosen second vice-president. Directors are: J. Robert Britton, Charles W. Humme, George N. Voorhees and Chester K. Wentworth.

ALBERT G. WYLER, principal assistant city engineer of New Orleans, was elected president recently of the New Orleans Chapter of the American Public Works Association. N. L. Marks, city engineer of New Orleans, was elected vice-president and Albert H. Guillot was elected secretary-treasurer.

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Civil Service Examinations

U. S. Government: Senior Engineer, $4,600; Engineer, $3,800; Associate Engineer, $3,200; and Assistant Engineer, $2,600. All branches of engineering; appointments to Washington and field offices. Applications must be filed with U. S. Civil Service Commission at Washington by Aug. 14. See local post office for details.

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Pennsylvania Will Pay Job Abandonment Cost

Pennsylvania Governor Arthur H. James has signed the Tallman bill authorizing payment by the General State Authority of "damages and losses" sustained by the Authority in abandoning the Maximum Security Prison project at Mt. Gretna. McCloskey & Co., Philadelphia, holds the $1,469,000 general contract on the $2,428,866 project.

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Bonneville and Coulee To Have Second Line

A second interconnecting power line between the Bonneville dam and Grand Coulee dam has been approved by Secretary of the Interior Harold L. Ickes. Construction is to begin this year, according to Frank A. Banks, acting administrator of the Bonneville project. The new 220,000-volt line, estimated to cost $3,000,000, will take off at Chehalis, a terminal point of a previously authorized 220-kv. line and go to Grand Coulee via Tacoma and Seattle. Only a part of the total cost is available for construction this year.

This alteration in the master plan for a federal power grid in the Pacific Northwest, according to Banks, will have the following advantages: More certain transmission of power over two separate lines rather than two parallel lines. It will permit Bonneville and Grand Coulee both to serve five more Washington counties in which there are already organized public utility districts. Easy tie-ins with the Seattle City Light and Tacoma City Light systems and with the municipal system at Ellensburg, which already has requested Bonneville power, will be possible.

Coincident with the announcement of plans for a second line, Major Theron D. Weaver, Bonneville district engineer for the Army, advised that $7,000,000 has been allotted for work at the dam. This sum will allow for completion of the power house superstructure on units 3 to 6, which are now under contract to the L. F. Hoffman Construction Co. So far about $54,000,000 has been spent on the dam, the total cost of the generator plant being estimated at $75,000,000.

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Dam Authority Receives Conditional License

The Grand River Dam Authority has been granted a conditional license by the Federal Power Commission which allows the authority to proceed with construction by making possible federal condemnation of land and rights of way. The dam will be built for a lake level of 745 ft. However, railroads will be relocated to provide for a possible rise in the lake level to 750 ft. This is estimated to cost an additional $170,000, which will be provided by the authority.

Satisfactory construction progress is now being made on the project, 2700 men being employed with a weekly payroll of $72,000. The entire work is scheduled for completion in January 1940. (See *ENR*, Feb. 16, 1939, p. 64.)

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State Official Fined For Diverting WPA Labor

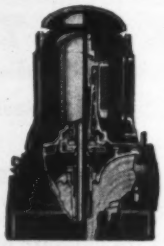
Pennsylvania State Senator Joseph P. Dando paid a $2,500 fine in the federal court at Philadelphia July 21 after he had been convicted of diverting WPA labor to his private use. The WPA labor had been employed on Dando's own swimming pool and amusement park.

STERLING
WHEELBARROWS

REASONS OF SUPERIORITY

Perfect Balance
10 Spoke Wheels
Channel Steel Legs
Interchangeable Parts
Clear Maple Handles
Welded Trays—No Rivets
Larger Rod in Top of Tray
V-Front Braces—Cross Supports

Sterling
WHEELBARROW CO.
MILWAUKEE, WISCONSIN



New models for
1940
now ready

Every year Peerless has brought forth many new and improved Turbine Pump refinements. Now, months ahead of the new year, Peerless announces still greater advances in design and construction. The new 1940 Peerless Pumps are actually years ahead of contemporary makes. For instance, the new Peerless "Hi-Lift" Pump is the most revolutionary improvement ever devised for deep well pumping. Its construction is utterly different. Write for our 1940 Catalog.

Factories:
Los Angeles, San Jose, Fresno, Calif.
Massillon, Ohio

★ WATER OR OIL LUBRICATION
Peerless
TURBINE PUMPS
PERFORMANCE WITH ECONOMY
Peerless Pump Division
FOOD MACHINERY CORPORATION

Two Ohio Road Men Return to Their Jobs

Two suspended Ohio State highway employees have been reinstated, one through common pleas court action and the other by the order of the Ohio civil service commission.

Robert M. Greenlun of Ashland has been reinstated as inspector by Judge Robert C. Duncan, who held that Greenlun was discharged Jan. 5 for "purely political and personal reasons," after testifying at the trial of I. R. Ault, head of the department under former Governor Martin L. Davey. The civil service commission reinstated H. R. Brandon, modifying his 75-day suspension from the job of Tuscarawas County timekeeper.

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Texas Advertises Highway Safety

A campaign to reduce highway accidents is being launched in Texas this month jointly by the Texas Good Roads Association, the Texas Highway Commission and the Department of Public Safety. The major program, an attack on careless driving, will consist of publishing of a series of newspaper advertisements aimed at educating the public to the responsibilities of motor vehicle operation and the dangers of carelessness.

Lowry Martin, president of the Good Roads Association, in deploring the needless highway accidents of last year, stated, "Traffic experts have determined that education of the public is one of the most effective means known to alleviate this appalling condition. The press of Texas has played a prominent part in the past few years in making Texans safety conscious and newspaper editors and publishers have given generously of their time and space in the safety movement. It was with the thought of making the efforts of the newspapers along this line more effective that the two official state agencies and the Good Roads Association joined in this movement."

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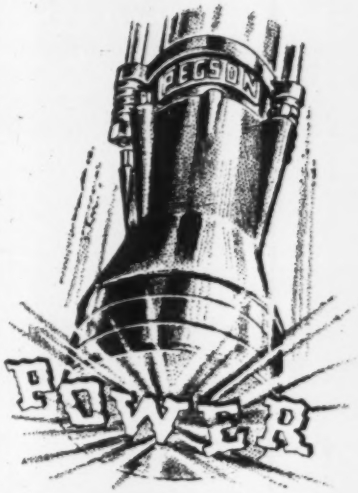
Memphis Gets Two Million For Public Works

Memphis, Tenn., has been allotted $1,500,000 for a negro slum clearance project, and $864,000 for employment of relief labor in flood control work. The new slum project will be Memphis' fifth such undertaking, a balance of $1,000,000 to the credit of Memphis being left over from allotments for previous slum clearance projects.

PEGSON



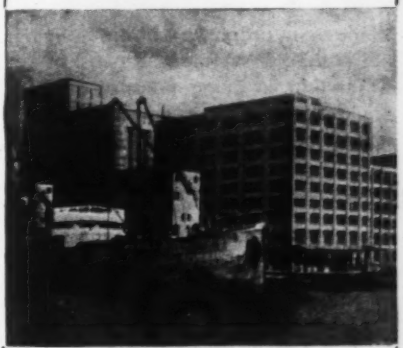
RAMMER

The Pegson Power Rammer is a sef-contained tool and runs on ordinary Gasoline. Definite consolidation of all back filling is obtained and there is no subsequent subsidence. The machine is entirely automatic in operation and imposes no strain upon the operator.

Built in three models suitable for wide or narrow trenches, bridge footings, etc.

. . . on jobs like this you need them!

Dockside buildings need firm foundations . . . and they'll be firm alright if Pegson Rammers are used.



PEGSON RAMMERS
"Agents required to sell Pegson Rammers in certain areas both in U.S.A. and South America"
Pegson Ltd., Coalville, England

Bailey Meters AT BOULDER DAM

● In Boulder Dam Power Plant as in many other new hydro-electric stations including Madden Dam and Norris Dam, Bailey Fluid Meters are installed on hydraulic turbines.

At Boulder Canyon, the Bailey Meters measure water supply through 13 foot diameter penstocks under an average head of 530 feet. These meters indicate and record the water flow in terms of cubic feet per second and continuously integrate in millions of cubic feet. The registers are operated by pressure connections in the turbine scroll casings.

While your project probably does not entail the volume and head of water that is being measured at Boulder Canyon, it is nevertheless, important that your measurements of flow and liquid level be accurately made by reliable equipment.

Write for complete information on the application of Bailey Meters to your problem. MU-19

BAILEY METER · COMPANY ·

1029 Ivanhoe Road, Cleveland, Ohio

BAILEY METER COMPANY LTD., MONTREAL

Baltimore Ordinance Affects Housing

An ordinance authorizing the Housing Authority of Baltimore to follow certain engineering practices in the construction of its housing projects has been passed by the city council and approved by Mayor Jackson. The changes were also approved by Frank K. Duncan, chief engineer of the city, who has pointed out that while these changes are in conflict with some of the requirements of the city's present building code they conform with provisions of a new code now being prepared.

The ordinance requires a 3,000-lb. concrete for Class A, a 2,500-lb. concrete for Class B, and a 2,000-lb. concrete for Class C, strength being controlled by the water-cement ratio, with all mixes 1 part portland cement, 2.5 parts fine aggregates, and 3.5 parts coarse aggregate.

It also stipulated that aggregates shall be measured in a dry rodded condition with fine and coarse aggregate measured separately by volume, and that the maximum slump of all three classes of concrete be 4 in. All concrete must be mechanically vibrated when being placed.

The maximum stresses for reinforcing steel are set at 18,000 lb. per sq.in. in compression and 20,000 lb. in tension, reinforced concrete to be designed in accordance with formulas and requirements of the Progress Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete dated January 1937.

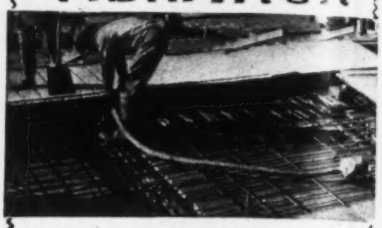
A special concrete inspector, approved by the buildings engineer and under his supervision, shall be employed by and at expense of the owner at all times when concrete is being placed. In all other respects buildings shall be erected under the supervision of the city's bureau of buildings in accordance with the building laws and zoning ordinance.

• • •

New York Crossing Jobs Reduced for 1939

The New York Public Service Commission has reduced from 33 to 15 the number of grade crossing elimination projects which railroad companies and the state department of public works had urged for addition to the 1939 program. The additional cost under this schedule is $6,600,000. The largest individual project to be approved by the commission for addition to the 1939 program involves the elimination of five crossings of the New York Central in the city of Oneida, at an estimated cost of $3,200,000.

VIBER COMPANY CONCRETE VIBRATION



More Profit to You ON LARGE CONCRETE CONSTRUCTION

We recommend Model 12 Flexible Electric Vibrator for use on large reinforced concrete building construction in walls 10" thick and over, piles in place, foundations, footings, large girders, thick floor slabs, columns. Especially adapted to concrete arches and rigid frame structures, and main and auxiliary hydraulic structures. Will successfully handle concrete with large aggregate and a low water-cement ratio. Write for complete Viber data today.

with Model 12 FLEXIBLE ELECTRIC VIBRATOR

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FREE TO YOU

Two New Bulletins

"TECO Connector Manual"

and

"How to Design and Fabricate TECO Structures"

will come in handy in your engineering library. Complete design and use data for light and heavy frame timber structures.

The engineers' "timber handbook", Wood Structural Design Data and Supplements, 300-page book published by National Lumber Manufacturers Association, price $1.00, U. S. postage paid.

TECO TIMBER CONNECTORS Stronger Joints Less Material

TIMBER ENGINEERING CO.

1337 Connecticut Ave.

Washington, D. C.

Road Fund Diversion Proposed in Wisconsin

Governor Heil of Wisconsin is proposing a new tax plan for trucks and buses which will, if passed by the legislature, reinstate diversion of the state's highway funds to the state's general fund in an indirect way. He wants to reduce the registration fees of trucks and buses and reenact a truck and bus tax as an occupational tax.

In 1938 truck owners paid $3,068,786 and bus owners $207,573, a total of $3,276,359 which went into the state highway fund. Under the governor's plan the registration fees, now paid according to eighteen different weights, would be reduced to a sum not to exceed $35 for each truck or bus. This would yield $3,000,000 to the general fund.

• • •

Texas Highway Department To Assume More Costs

The Texas legislature has passed a road bond assumption bill which broadens the present law to assume indebtedness for road construction other than state highways. It will become effective immediately upon approval of Governor Lee O'Daniel.

Termed one of the major achievements of the session, the bill would dedicate one-fourth of the proceeds of the gasoline tax for 25 years or more to retirement of practically all the outstanding indebtedness of counties and road districts incurred in building both roads taken into the state highway system and those in lateral road systems. It is estimated that it will relieve counties and districts of as much as $115,000,000 of indebtedness.

• • •

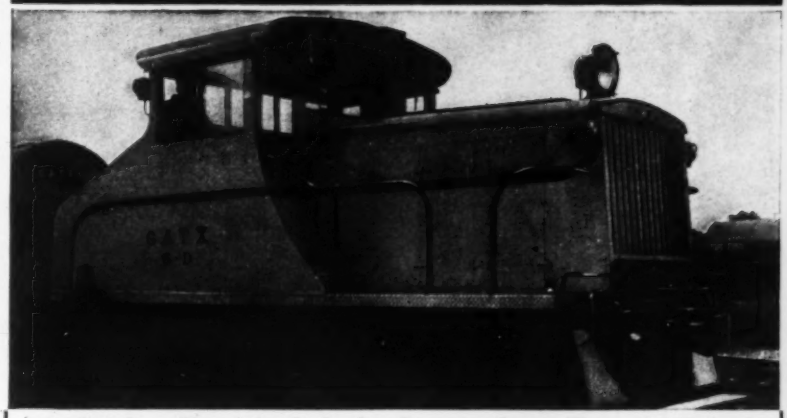
Euphrates River To Be Controlled

A flood control project for the Euphrates River in Iraq is now being carried out at a cost of $4,500,000. Construction calls for a 4½-mi. canal to Lake Habbaniyah. Regulation of the lake level will be by discharge through a 5-mi. outlet channel into a depression in the desert where evaporation and adsorption will take care of disposal.

A prospective future development is a second outlet channel leading from the lake to a lower part of the river. During low river stages lake water would be run through this channel to augment river flow. Coode, Wilson, Mitchell and Vaughan-Lee of London are the engineers and Balfour, Beatty and Co. of London has the general contract.

Plymouth FLEXOMOTIVE

GIVES YOU *EVERYTHING* YOU WANT IN A LOCOMOTIVE!



Built for Tough Jobs! *Proved* on Tough Jobs!

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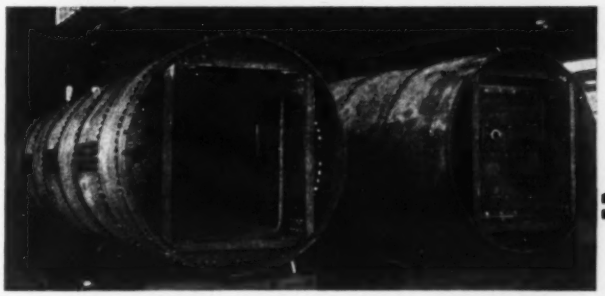
PLYMOUTH FLEXOMOTIVE

DOLLAR FOR DOLLAR—THE GREATEST LOCOMOTIVE EVER BUILT!



Sectionalized Bolted MAN LOCKS

UNION DEPENDABILITY

—*essential in* AIR LOCKS

***Bulletin* 163 covers the entire line of Union Equipment . . . send for your copy**

Where lives, equipment and time schedules depend on Air Locks—you take no chances with UNION. We design and build, and assume complete responsibility for every detail.

We build every type of vertical and horizontal Air Locks, including many special designs developed by us over the past 35 years.

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POZZOLITH

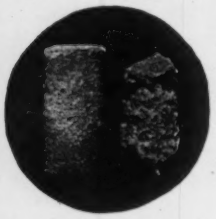
Sewage Disposal Plant, Pueblo, Colo.
Engineers—Black & Veatch, Kansas City, Mo.
Contractors—Thos. Bates & Son, Denver, Colo.
Schwartz Construction Co., Colorado Springs, Colo.

LEAN MIXES EASILY PLACED WITH POZZOLITH

• A report from the Pueblo Sewage Disposal Plant project states, "Approximately 7½% more fine and coarse aggregate was used than on previous work with the same materials, and with practically no difference in 28-day age strengths . . . a slump of 2 inches was obtained with the use of Pozzolith as compared with a slump of ¾" for the same mix without Pozzolith."

Lean mixes, used to control shrinkage and heat, are made easily placeable with Pozzolith with no honeycombing or water gain . . . benefits which are advantageous for YOUR projects. Send for full information today.

PROOF OF EXTRA DURABILITY



Pozzolith concrete is durable concrete! 200 cycles of freezing and thawing prove the greater durability imparted to concrete by Pozzolith. Pozzolith concrete lost only 2% in weight . . . plain concrete lost 22.9%!

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NEW AIDS TO THE CONSTRUCTOR

Equipment and material announcements and manufacturers' news

Tournacar Welder

The 1939 Tournacar welder rides in a GMC half ton panel delivery sedan with a 6 cylinder valve-in-head motor, 4 speed transmission and oversize 7.50x15 tires. This portable service welding outfit is equipped with a 200-amp. SA. Lincoln welder which is driven through a power take-off from the truck's engine. The welder has a patented dual continuous control of both voltage and amperage and can be used on any thickness of metal from 22 gage up. Maximum welding rod size is $\frac{3}{16}$ in. The welder, which weighs 320 lb., occupies only a small part of the truck storage space. There is 120 cu.ft. of space free for storage of oxygen and acetylene tanks, tools, parts, etc.

In *Engineering News-Record* for June 22 it was erroneously stated that the Tournacar welder is a service car used only by R. G. LeTourneau, Inc., Peoria, Ill., its manufacturer.

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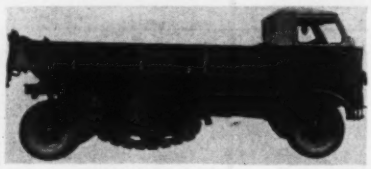

Convertible Haulage Unit

Convertibility from track to wheel operation is the outstanding feature of the Linn Model C-5 manufactured by the Linn Mfg. Corp., Morris, N. Y. The conversion is accomplished by throwing a control lever mounted at the driver's position.

The illustration shows the C-5 operating on dual pneumatic tired wheels, with 7 in. of road clearance under the traction unit. In this position the drive is on the front wheels; the traction unit idling, and merely revolving should it hit an obstruction. Load distribution is equal between front and rear axles. Maximum speed is 35 m.p.h.

When track operation is desired, the operator pushes the control lever and the rear wheels are raised hydraulically. The wheels can be raised to allow 9 in. of road clearance, or they can be allowed to trail or float behind the traction unit. The unit is of the flexible Linn design which provides ample traction over uneven surfaces. When the C-5 is operating on tracks, the load distribution is 75 per cent on the tracks and 25 per cent on the front wheels, with the drive on the tracks and front wheels simultaneously. Maximum speed, loaded, on tracks is 12 m.p.h.

The body capacity of the C-5 is 5 tons, the chassis weight with cab approximately 11,500 lb. The engine is a 6-cylinder Hercules, rated at 105 B.H.P. at 2400 r.p.m. Gasoline or diesel power is optional.

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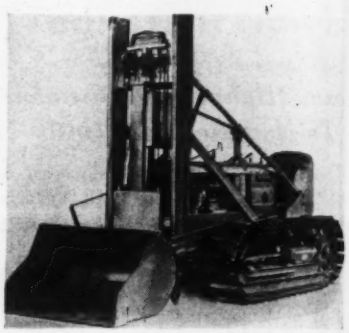

Tractor Shovels

Two new models of tractor shovels, the special modified International T-35 and TV-35, have been announced by the Frank G. Hough Co., Chicago. These new shovel models are built around special T-35 and TV-35 tractors which have been modified for special shovel service. This modification includes special long tracks, six roller truck frames, spring loaded foot clutch, double steering clutches, reversed radiator fans, etc.

• • •

Measuring Standards

The George Scherr Co., New York, has just placed on the market a new set of precision measuring standards under the trade name of ULTRA-set. The set consists of nine length standards accurate to 8 millionths of an inch and will make 71 combinations in steps of $\frac{1}{8}$ in. up to $4\frac{7}{8}$ in. and 41 combinations in steps of 0.100 in. up to 4.1 inches.

Also available with the ULTRA-CHEX is the Scherr optical parallel, accurate in planeness within 4 millionths. This is used to check the parallelism of micrometer anvils by observing light interference bands on both anvils.